UCID- 21333

CHAWS USER'S GUIDE:
SYSTEM DESCRIPTION AND STANDARD OPERATING PROCEDURES
Pine Bluff Arsenal

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Lawrence Livermore National Laboratory

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PREFACE

The Chemical HAzard Warning System (CHAWS) has been designed to collect meteorological data and to display, in real time, hazardous chemical dispersion as a result of an accidental release. Meteorological sensors are placed strategically around each installation and are used to calculate direction and hazard distance for the release. These data are then graphically displayed on a computer screen showing a site map and arrows depicting the release direction and distance traveled.

The objectives of CHAWS are as follows:

- To determine the trajectory of the center of mass of released material from the measured wind field
- To calculate the dispersion based on the measured lateral turbulence intensity (sigma theta).
- To determine the height of the mixing zone by measurement of the inversion height and wind profiles up to an altitude of about 1 km.
- To archive meteorological data for potential use in climatological descriptions for emergency planning.
- To archive air-quality data for preparation of compliance reports.
- To provide access to the data for realtime hazard analysis purposes.

The latter function is provided at a minimum by the PC-version of the Army code D2PC, which is resident in the central computer. Although D2PC has limited capability to use the full power of CHAWS meteorological data, it is noted for its variety of source-term scenarios that can be selected by an operator to estimate the downwind distance to a hazardous concentration limit.

The CHAWS system has been made as easy to use as possible, but because it has a wide variety of functions, learning to use it correctly may take some time. Users should

- have a basic knowledge of the Microsoft Disk Operating System (MS-DOS) and an understanding of how to use computers.
- read each chapter carefully before attempting to use the system.
- work through the steps explained in each section to learn the correct techniques to fully use all the capabilities of CHAWS.

Operators probably will need to go through the manuals more than once to have a good understanding of how the system works. The more an operator uses the system, the easier it becomes; however, the manuals should always be kept within easy reach as a reference. Summary documents have been provided for some of the systems, and trained personnel, after learning system operations from the manual, may find these to be all they need to carry on day-to-day operations.

Because the systems installed at the various Army sites have different configurations, we have written this manual in five volumes, each tailored to a specific site. They are as follows:

- UCID-20988 - Tooele Army Depot Air Quality Monitoring Systems User's Guide: Description, Standard Operating Procedures, and Installation Report. (In addition to the Tooele Depot, Pine Bluff Arsenal also uses this volume.)
- UCID-21333 - CHAWS User's Guide: System Description and Standard Operating Procedures--Pine Bluff Arsenal
- UCID-21334 - CHAWS User's Guide: System Description and Standard Operating Procedures--Tooele Army Depot.
- UCID-21335 - CHAWS User's Guide: System Description and Standard Operating Procedures--Edgewood Area, Aberdeen Proving Ground.
- UCID-21336 - CHAWS User's Guide: System Description and Standard Operating Procedures--Lexington-Blue Grass Army Depot.

The CHAWS major components are as follows:

- The Emergency Operations Center (EOC) central computer described in Chapters I and V.
- The network of meteorological towers (Chapter II).
- The network of air-quality monitors (UCID-21338).
- The SODAR meteorological sounding system (Chapter III). (This chapter applies only to the Edgewood and Pine Bluff manuals.)
- The data acquisition radio system (Chapter IV).
- The specialized data processing and display software (Chapter VI).

ACKNOWLEDGMENTS

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Chapter I
DAILY OPERATIONS GUIDE

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1.0 INTRODUCTION

A regular workday at a Chemical Hazard Warning System (CHAWS) site consists of many activities. This chapter gives a brief overview of what is necessary to run the system on a daily basis. Other chapters of this manual (see Preface) present more details of the hardware and software found at the CHAWS sites so that troubleshooting and maintenance can be performed on the system. Also, manuals have been provided for the hardware manufactured by HANDAR and the computer companies. This manual is meant to serve as a supplement to those hardware manuals. Personnel operating the CHAWS system should be familiar with the MS-DOS system. Manuals were provided with the hardware that instruct the user in DOS commands and procedures.

CHAWS sites are located at the Pine Bluff Arsenal, Arkansas, Edgewood area of Aberdeen Proving Ground, Maryland, Tooele Army Depot, Utah, and Lexington-Blue Grass Depot, Kentucky. These sites have different systems with different features and various types of hardware. The basic system, however, is the same.

2.0 DAILY ACTIVITY SUMMARY

The CHAWS central computer consists of a host IBM PC/AT computer and two or more Kimtron terminals (see Figure I-1). The primary function of the host computer is to log and process data from the meteorological and air-quality (where applicable) systems. It can be run with or without graphic display. For either case, the system should be started as described in Section 3.0.

Booting (starting) the system corrects for any time drift and eliminates any accumulated errors. Booting is recommended at least once a day.

If the system does not perform as expected, consult the Troubleshooting section in Chapter V, CHAWS Computer System. All technical terms are defined

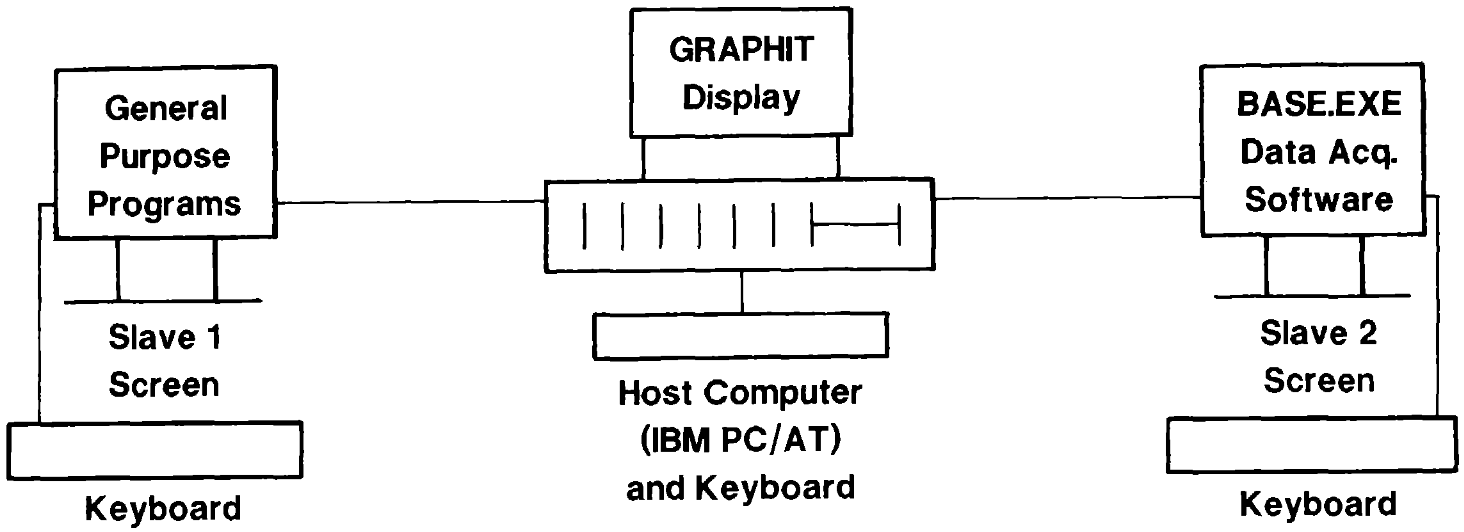

Figure I-1. Data and model display hardware.

in the Glossary (Appendix I-A). Parameters and units are described in Appendix I-B.

Important note: often a command will be entered, and the system will appear not to be performing the operation. Please be patient, as the system may be busy running another operation. Occasionally an operation will take 30 to 60 seconds.

ON ARRIVAL: Check the screens to see that the host and slave computers are performing properly. The host should be running LOGIT with the Slave 2 screen showing current data as described in Section 3.5. Shortly after the end of a data poll, reboot the system by striking the <Ctrl>, <Alt>, and <Del> keys simultaneously on the host computer (twice if necessary). <Ctrl> and <Alt> are on the left side of the main keyboard, while <Del> is in the lower right corner of the numeric keyboard. Strike <Ctrl> and "c" simultaneously. After the message "Terminate batch job (Y/N)?" appears, type "y". Make sure you are in the HANDAR subdirectory. After LOGIT starts running again, the graphics may be started by typing "GRAPHIT" after obtaining a DOS prompt (see Section 4.1). The screen will then display a map and graphs.

DURING THE WORKDAY: Check the Kimtron Slave 2 terminal screen to make sure it is displaying data from the most recent period and that the clock in the upper right-hand corner is running. Check the host computer screen to make sure the wind trajectory and other meteorological conditions are also updating regularly with data from the most recent 2 hours shown on the graphic display.

DAILY: Copy only the *.WX files to 1.2-M byte floppy disks. About 10 to 20 days of data should fit on one disk. Check Section 4.0 of Chapter VI, Graphic Display and Data Processing Software, for correct archiving procedures. If you want to calculate 5-minute averages or are undecided on what data to archive, you can also save the *.HR, *.HLY, and raw data files.

UPON DEPARTURE: While a data poll is in progress, or shortly after a poll, bring the host monitor out of the GRAPHIT mode by striking the <Ctrl> and <Brk> keys simultaneously. "Terminate Batch Job? Y/N" should appear in the upper left portion of the screen; type "y". To clear the graphics off the screen, type "clear" <Enter>, then "cd/handar". At the DOS prompt, type "logit". IMPORTANT - do not strike the <Enter> key at this time (if a poll is in progress). After the current poll is complete, the words "1 file copied" will appear three times in the lower left corner of the Slave 2 screen. At this time, strike <Enter> to start LOGIT on the host. The red light should start flashing almost immediately--if not, press <Ctrl> and "c" simultaneously, answer "y" to the terminate question, and retype "logit" <Enter>. After a few seconds, the words "1 file copied" should appear twice on the host screen, and then the screen will go blank. When the hard disk stops working, a blinking cursor should appear on the host monitor. When this occurs, LOGIT is running. Turn the brightness controls down after watching one more poll to ensure that LOGIT is running properly.

TWICE WEEKLY: Attach a small printer to the Envirologger at each of the air-quality monitoring sites to obtain the latest data report from each air-quality analyzer. This is the only way to check for erroneous negative air-quality values. If such values exist (below -0.05 ppb), those analyzers need to be recalibrated as soon as possible. Data gathered since the last check should be flagged. See UCID-20988, System Description, Standard Operating Procedures, and Installation Report* for details on this procedure.

3.0 BASIC OPERATION (WITHOUT GRAPHIC DISPLAY)

Any type of boot-up (warm or cold) should cause the host computer to enter the LOGIT mode automatically. This mode runs the RDHAND2 program, which transforms short-term data from the form shown on the Slave 2 screen to *.WX files for more efficient storage. However, if you need 5-minute averages for on-site use, you must save the raw data and use it to calculate the averages.

For a graphic display on the host-computer screen, the GRAPHIT mode is used to run WXGRAPH. Before entering this mode, start the system and check its operation.

Follow the procedures given below, and if the system does not respond as described, consult the Troubleshooting section in Chapter V, CHAWS Computer System. Read Chapter VI, Graphic Display and Data Processing Software for a detailed description of the software and its operation.

3.1 <u>Power-on check</u>

Check the green LED on the upper left front panel of the host. If the light is on, check the screens to see if they appear as described in Section 3.5. If they do not, try the warm restart (<Ctrl>, <Alt>, <Del>) described in

*Some sites don't have this. If a particular reference in the text doesn't apply to your site, don't worry about it.

Section 3.3. If this fails, or if the green light is not on, proceed to the cold start-up procedure in Section 3.2.

3.2 Cold start-up

If the green LED on the host's front panel is off, start the system cold ("cold-boot" it) without graphic display by the following procedure:

1. Turn on the host computer (power switch is on the right side panel of the IBM-PC/AT near the back).

2. Turn on each of the 3 screens (if the power switch is not on the front panel, it is usually on the back near the power cord) and the printer.

The green LED should now be on. The number of kilobytes of memory tested appears in the host's upper left screen. The host will also test the slave memories before it starts running the LOGIT program. While program and data files are being loaded, the red hard-disk-access LED (on the front panel just to the right of the green power-on LED) will flash. Any file-copy messages on the screen will disappear when LOGIT starts running, leaving only the cursor in the upper left corner.

3.3 Warm restart

If the green LED on the host computer's front panel is on, the system can be restarted warm ("warm-booted") to enter or reenter LOGIT mode (without graphic display). This will terminate any programs currently running on the host or any slave terminal and thus should be done only between data polls. (WARNING--all volatile internal memory will be erased).

Reboot the system by simultaneously striking the <Ctrl>, <Alt>, and <Del> keys on the host computer keyboard (twice if necessary). The screen will clear, and a flashing cursor will appear in the upper left corner of the screen. The reboot process will display file-copy messages on the screen while the red hard-disk-access LED on the front panel flashes. When the host runs LOGIT, the file-copy messages will disappear, leaving only the cursor.

Confirm that LOGIT is running by comparing the Slave 2 Kimtron screen with the figures and discussion in Section 3.5. Note: if the system is locked up, the warm-boot process will not work. Turn the power off and turn the brightness controls down on the monitors prior to turning the power back on.

3.4 Terminating a program

Normally, a program should be terminated by following the instructions for that program (see Section 3 of Chapter VI, Graphic Display and Data Processing Software). Continuous programs such as LOGIT or GRAPHIT should not be terminated because the system may lock up or data might be lost. If necessary, these programs (but not the base station software) can be stopped by striking the <Ctrl> and <Break> (or <Scroll Lock>) keys simultaneously. This may need to be done several times. The DOS prompt character (ending with ">") will appear on the left side of the screen after a successful termination.

This procedure may be used to exit LOGIT and enter DOS to start the graphic display with GRAPHIT.

3.5 Kimtron screens

Figure I-2 shows the Kimtron Slave 1 screen display. The Slave 1 has a keyboard and is to be used for running the U.S. Army's D2PC downwind hazard program as well as data processing, file editing, and other programs. Operation of these programs is mentioned in Section 5.0. Data processing programs are described in Chapter VI, Graphic Display and Data Processing Software. Consult that chapter for details.

Figure I-3 shows the Slave 2 screen as it appears when the base station software, BASE.EXE, is polling data. Text in square brackets "[ ]" does not appear on the screen but is presented in the figure to explain what the lines of data represent. The top line in the box appears in brackets to indicate that it appears before a poll starts, whereas the data that follow do not.

Before the polling begins, the top 3 lines appear as in the figure. If "Polling enabled" appears, the system is ready to collect the next 15 minutes of data. Check the Julian date and time at the upper right to make sure they are current. (A table of Julian dates appears as Appendix I-C.)

Polling is scheduled to begin at the "-- Next poll time: " shown in the upper or lower center of the boxed area (always on a 15-minute interval). The

Figure I-2. Slave 1 terminal screen display

```
        ATNX Slave Processor -- Version 1.1
Copyright (C) 1984,1985,1986 by Alloy Computer Products, Inc.

                  User: 1

Mem Size: 471 K   Multi-User Drive C:  3744 K

Microsoft MS-DOS version 3.10

C>PROMPT $t$h$h$h$h$h$h  $p$g

 8:31  C:/>CD/D2PC

 8:31  C:/D2PC>
 8:31  C:/D2PC>


At Tooele: C:/>CD/D2
           C:/D2/>
```

Figure I-3. Slave 2 terminal screen display (from Pine Bluff instruments)

[NOTE: DATA SHOWN ARE NOT REAL-TIME]

```
Poll/Monitor mode        Polling enabled                          022 08:26:57

  [          --- Next poll time:  022 08:30:00  DCP 00000001 ---            ]

64 022 08:19:59 00:05:00 001.5 001.5 001.6    [5-min wind speeds]
66 022 08:29:40 00:15:00 021.3                [15-min temperature]
           --- Next poll time:  Now.  1 poll  waiting. ---

  --- Polled data from DCP 00000007 from 022 08:15:00 to 022 08:30:00 ---
00000007 022 08:35:05                         [Station 7, Jul date, time]
01 022 08:29:00 00:15:00 13.3                 [15-min battery voltage]
02 022 08:29:50 00:15:00 0.000                [15-min air qual CAL voltage]
03 022 08:19:50 00:05:00 0.000 0.000 0.000    [NO  5-min voltages]
07 022 08:19:50 00:05:00 0.001 0.001 0.001    [O3  5-min voltages]
08 022 08:19:50 00:05:00 0.001 0.000 0.000    [SO2 5-min voltages]
09 022 08:19:50 00:05:00 0.000 0.000 0.000    [NOX 5-min voltages]
61 022 08:19:57 00:05:00 000.9 000.9 000.9    [5-min wind speeds]
63 022 08:19:59 00:05:00 179 179 179          [5-min wind directions]
64 022 08:19:59 00:05:00 001.6 001.5 001.8    [5-min sigma theta]
66 022 08:29:40 00:15:00 021.4                [15-min temperature]
           --- Next poll time:  022 08:45:00  DCP 00000001 ---

1 Enable polling  2 Display status  3 Reset poll  4 Disable polling  10 Return
```

Explanations:

(Data Description Line)

```
[CH|JUL|HR MN SC|HR MN SC|AV #1 AV #2 AV #3|]
[DATA|DAY|TIME  |AVG. PER|5 OR 15-MIN. AVG.|]
```

FIRST LINE

CH : Channel number for data
JUL: Julian date (see Appendix C for Julian dates).
HR : Hours
MN : Minutes
SC : Seconds
AV #1, AV #2, AV #3 : Averages for first, second and third 5-min periods (Only AV #1 appears for a 15-min period)

SECOND LINE

DATA : Refers to data-channel-type number above
DAY : Refers to Julian date above
TIME : Refers to local standard time
AVG. PER : Averaging period (Columns specify periods in HR, MN, SC)
5 or 15-MIN AVG. : Refers to averages given above

"   DCP 00000001 ---" represents the next station (data-collection platform) to be polled (in this example, Station No. 1).

The rest of the figure shows how the screen appears at the end of a poll, at which time the "Next Poll Time ..." line at the bottom of the boxed area shows the time of the next scheduled poll. Note: data shown were taken inside a laboratory and do NOT represent a real atmospheric scenario. Station and channel numbers vary from site to site.

As the data representing 5- and 15-minute averages move up the Kimtron Slave 2 terminal screen, the "Polling Enabled" remark at the top will change to "Polling DCP 00000001 (2, 3, etc.)" as each station is polled. To the right of this remark will appear either "Transmitting," "Awaiting Response," or "Receiving," indicating the current activity of the HANDAR 542 base station.

Figure I-3 shows the Slave 2 screen as it should appear when it is displaying current data. Make sure the clock in the upper right displays the current time and that the display follows the format given. If BASE.EXE does not appear to be running and displaying a screen as in the figure, reboot the system (Section 3.3) or consult the Troubleshooting section in Chapter V, CHAWS Computer System.

The bottom line (below the boxed in area) is explained in the HANDAR Base Station Software Manual.

3.6 Restoring polling mode

If the radio base station software is in a menu other than "Poll/Monitor mode," strike <F10>; wait until the main menu appears; then strike <F2>. The polling menu should now be on the screen. If the message "Polling enabled" does not appear in the upper center screen, consult the Troubleshooting section in Chapter V, CHAWS Computer System.

4.0 GRAPHIC DISPLAY MODE

This mode employs the batch file GRAPHIT that runs WXGRAPH to obtain a graphic display of the meteorological parameters. GRAPHIT will also run RDHAND2 to create the *.WX files for efficient storage of the 15-minute data periods.

You must enter this mode after the system is started and data are properly being collected (see Section 3). If the Kimtron Slave 2 screen is operating with data collection as prescribed in Section 3.5, you are ready to enter GRAPHIT mode.

4.1 Entry into graphic display mode

If the computer is not running, start it by the procedure previously described in Section 3.2. If LOGIT is already running, terminate its operation (between polls ONLY) by striking <Ctrl> and <Break> simultaneously. When a prompt appears (">"), type "graphit" on the host computer's keyboard followed by <Enter>. This should start GRAPHIT whether in the HANDAR directory or the root directory.

4.2 Screen display

The above procedure enters the GRAPHIT batch file commands to the host computer and starts the operation of WXGRAPH. The parameters described below are assigned by the WXGRAPH.INI file. They can be changed by editing this file per the instructions given in Section 3.1.6 of Chapter VI, Graphic Display and Data Processing Software.

Upon completion of the steps in Section 4.1, the host screen will draw the map and show wind direction arrows and trajectories. It will also plot time-series graphs of wind and temperature on the right-hand side as explained in Section 3.1.7 of Chapter VI, Graphic Display and Data Processing Software. The plots typically show the values of four different meteorological parameters over a 2-hour period, wind speed and direction, standard deviation of wind direction (sigma theta), and temperature. The times appear to the right of their respective tick marks along the bottom axes of these time-series graphs.

The display is self-explanatory. Arrows at each CHAWS monitoring station point downwind (in the direction the wind is blowing). For definitions of parameters and units, see Appendices I-A and I-B, respectively. Important note: remember that the trajectories are based on past data (with the latest wind direction at the far end of the trajectory). They are not snapshot plumes or projections of future air-parcel trajectories. A detailed explanation of the trajectories appears in Section 3.1.5.4 of Chapter VI, Graphic Display and Data Processing Software.

5.0 MODELING AND DATA-PROCESSING SOFTWARE

This section lists the software that can be run on the Slave 1 terminal. For complete descriptions of these programs, see Chapter VI, Graphic Display and Data Processing Software.

5.1 Downwind hazard prediction model - D2PC

For emergency purposes, the Slave 1 Kimtron terminal is set up to run D2PC immediately as long as the subdirectory containing D2PC is active. The subdirectory is either D2 or D2PC, depending on the site. Simply type "D2PC" and strike <Enter> and follow the instructions on the screen. Familiarity with the program is required. Consult the D2PC manual, Personal Computer Program for Chemical Hazard Prediction (D2PC), by Whitacre et al., CRDEC-TR-87021 (1987 or a later edition) for operational details as well as a technical description.

5.2 Data-processing and editing software

Data-processing software should all be run on Slave 1. This includes WXSUMP, AQHRS, AQCAL, AQHTAB, and RECOV. Editing and spreadsheet software such as PE2 and LOTUS may also be operated from this screen. Consult the respective chapters.

Appendix I-A: Glossary of Terms

Ambient: Characteristic of the air surrounding a site or station.

AQ--Air Quality: A measurement representing ambient air quality. Those observed from the CHAWS analyzers include the CAL value (Channel 2), NO (Channel 3), O_3 (Channel 7), SO_2 (Channel 8), and NO_x (Channel 9). Each of these is defined below.

ASCII--American Standard Code for Information Interchange: The standard code used by most computers, consisting of 8-bit characters (7 bits plus parity check). The characters may be alphanumeric (letters or numbers), symbols, punctuation, graphic, or device-control characters. They can be sent to a device such as a screen, printer, etc., and are easily read by a user.

Baud rate: The number of bits per second being transmitted.

Binary: The common denominator of all computer codes. The language actually used by the computer. Consists of nothing but open or closed circuits representing zeros and ones, which are translated by the computer from either base 2 to base 10 numbers, to "yes" or "no," or "true" or "false," depending on the frame of reference. Binary is the most efficient language for computer speed and data storage but cannot easily be read by a user. *.WX and *.HR files are stored in Direct Access Binary code.

Bit: The smallest piece of computer information. One binary element (i.e., 0 or 1).

Boot: To start a computer system.

Byte: Eight bits. Equal to one ASCII character.

CAL: Calibration mode--the mode where an air-quality analyzer is checking a ZERO or SPAN value instead of reading ambient concentration. A CAL value can represent the ZERO or SPAN value for an analyzer or the voltage for Channel 2.

Character: A single symbol appearing on a screen (usually 1 byte).

Code: A computer program or programming language (such as BASIC, FORTRAN, or COBOL).

Cold boot: Starting the computer from a power-off position by turning the power on.

Concentration: Volume or mass of air pollutant per volume of air.

Criteria pollutant: Any atmospheric contaminant regulated under the Clean Air Act. These include sulfur dioxide, oxides of nitrogen, non-methane hydrocarbons, ozone, carbon monoxide, and particulates (including lead).

Cursor: The character-sized spot of flashing light on the screen that shows where data entered from the keyboard will appear.

Data: Any information obtained from or used by CHAWS.

DCP: Data-collection platform--found at most CHAWS monitoring stations.

Degrees: Used to define temperature or wind direction. CHAWS system uses Centigrade for temperature (see Appendix I-B).

Deposition: Rate or total amount of airborne emission material deposited on a unit area of land.

Device: Anything (such as a screen, keyboard, printer, disk drive, or modem) attached to a computer, to which it directs or from which it obtains data. Also called a peripheral.

Diffusion: The spreading out of a puff or plume of pollutants as a result of molecular (or, sometimes, turbulent eddy) motions.

Directory: A series of files organized onto a common source. Must be "active," or it requires the directory name in addition to the filename to access its files.

Dispersion: The spreading out of a puff or plume of pollutants as a result of mixing by turbulent eddies.

DOS: Disk operating system--the command interpreter program used by the IBM PC that controls the movement of information on the computer.

Emission: The release of a substance into the atmosphere.

Firmware: A set of instructions stored in read-only memory (ROM).

Floppy disk: A flexible disk in a square packet containing digitally encoded, magnetically stored data. For an IBM microcomputer, the disk packet is 5 1/4 inches square and holds either 360 kbyte (double sided, double density) or 1200 kbyte (high density, also called 1.2 Mbyte).

Disk drive: A device for reading data from or writing data to a disk (either hard or floppy). When the red light is on, data are being read or written. A floppy-disk drive is usable when a floppy disk is inserted into the slot and the gate (an arm about an inch long) is pointed in a vertical direction (CLOSED). It cannot read data if the arm is horizontal (OPEN).

Function keys: Keys that perform predefined functions on the keyboard, such as help, save, file, or quit (F1, F2, F3, F4...).

Gradient: The rate of decrease of a parameter with distance along a vertical or horizontal axis.

Hard disk: A mass storage device that can hold much more data than a floppy disk (usually 20 to 30 Mbyte). For the IBM PC/AT, it is installed internally and is not visible from the outside. When data are being accessed (read or written), the red light on the left front panel of an IBM PC/AT (next to the green power-on light) flashes.

Hardware: Any piece of equipment that exists physically in a tangible sense (instruments, wiring, circuits, circuit boards, computers, etc.)

Impact: The amount of a downwind ambient concentration or deposition that is attributable to a given emission source.

Increment: Allowable increase in ambient air-quality concentration permitted under the PSD Regulations in the Clean Air Act.

Interactive: A type of program that requests data from a keyboard.

Inversion: An atmospheric layer in which the temperature actually increases with height. (The SODAR reports any discontinuity in temperature change with height as an "INV"ersion. This could simply be a more stable layer than the layer below it.)

Julian date: The number of days since the start of the year, starting with Jan. 1. Julian day 25 is Jan. 25, day 50 is Feb. 19, etc. Starting with March, leap years have 1 day added. A table of Julian dates appears in Appendix I-C.

Kimtron: Brand name for the computer terminal used as displays for the slave cards.

Kilobyte (or kbyte): 1024 bytes of data storage.

LLNL: Lawrence Livermore National Laboratory--a division of the University of California.

Megabyte (or Mbyte): 1,048,576 bytes of data storage.

Memory: Any means of data storage that can be accessed by a computer.

MET--Meteorology: Weather parameters such as wind direction, wind speed, sigma theta, temperature, and relative humidity.

Mixing height: The height to which airborne material will rise as a result of mixing when released at ground level.

Modem: A device that allows computers to exchange information over telephone lines.

Modified sigma theta: The method used by the CHAWS system to determine atmospheric stability class. Incorporates sigma-theta values, vertical temperature gradient, and wind speed.

NO: Nitric oxide--a colorless gas created by chemical combination of oxygen and nitrogen in intense heat. One of the oxides of nitrogen dioxide in the atmosphere. Monitored by CHAWS Channel 3.

NO_2: Nitrogen dioxide--a light-brown colored gas. Toxic in high concentrations over long periods. Obtained from the CHAWS system by subtracting NO from NO_x (Channel 3 from Channel 9).

NO_x--oxides of nitrogen: The total concentration of all gaseous compounds of oxygen and nitrogen. Monitored by CHAWS Channel 9.

O_3--Ozone: A somewhat volatile gas whose molecules consist of 3 oxygen atoms (most atmospheric oxygen has 2 atoms). Responsible for eye irritation and minor crop damage. Formed in the lower atmosphere by lightning or complex chemical reactions involving NO_2 and hydrocarbons in sunlight. Monitored by CHAWS Channel 8.

Parcel: A volume of air small enough to have essentially uniform characteristics, considered in comparison with and in isolation from its surroundings (i.e., as if in a bag).

Path: Computer term for the device, directory, and subdirectory.

PE2: Personal Editor, version 2: The editing (word processing) software used for the CHAWS system. It can be used to edit any ASCII file. A manual of all the PE2 commands is available.

Peripheral: A device used by a computer but not installed inside the main box, such as a keyboard, monitor, or printer.

Plume: The trail of smoke or other air pollutant emitted by a source. Usually elongated in the direction the wind was blowing when it passed the source. Not equivalent to a trajectory.

Polling: Scanning of all data collection platforms (DCP's) for the latest 5- or 15-minute average data. Done by BASE.EXE in the Kimtron Slave 2 terminal.

Pollutant: Any substance considered harmful or detrimental to the ecosystem.

Program: A set of instructions for a computer. Usually saved on a device for easy operation. (Most programs can be started by simply typing the main program name while in DOS command mode.)

Prompt: A character (or set of characters) appearing on a screen when it is ready for data entry. In IBM-PC DOS, it is a "greater than" sign.

Quality assurance (QA): Any method employed for filtering out bad data and correcting a data base. It includes deleting values that are outside certain limits (done using WXCONF.CNF), correction after calibration, and a number of other techniques.

RAM: Random access memory--the internal, volatile, memory-storage space available inside a computer for data or programs. The contents of this memory are lost if the computer is turned off or rebooted.

Reboot: See "Warm boot."

Resultant wind: The total wind vector obtained by connecting the rear of the first wind vector for a given period to the front (arrow end) of the latest wind vector for that period, provided all the intervening wind vectors are lined up in between. The trajectory follows the individual wind vectors, not the resultant.

RH, RHum: Relative humidity--the percent saturation of the air (100% means totally saturated, at which point clouds form).

ROM: Read-only memory--the internal memory-storage space in a computer that cannot be changed. This memory is not normally erased.

SigThe, $\sigma\Theta$, sigma theta: A statistical parameter relating to the horizontal crosswind motion of the air. Used in D2PC and other dispersion models to predict the spreading of a plume. CHAWS obtains this value by calculating the standard deviation (sigma) of the 300 samples of crosswind component vector angle to the mean wind (theta) in a given 5-minute period.

Slave 1: The data-processing terminal used for running long-term data-handling programs. Currently operates D2PC when required.

Slave 2: The data-processing terminal used for data collection. Operates the base-station software BASE.EXE in normal mode.

Slave 3: The data-processing terminal in the host computer used for SODAR data collection.

Software: A set of instructions that tell a computer how to perform a task. A specific software set may be referred to as a program.

SPAN: The reference value displayed on an air-quality analyzer to monitor the high end of the operational range during calibrations.

Stability: The tendency for a parcel of air to return to its original level when displaced vertically. A layer is stable when a parcel displaced upwards will be colder and heavier than the surrounding air. Related to the thermal structure of the layer. Vertical dispersion potential is inversely related to stability.

T, Temp: Temperature--the warmth of the air [i.e., the heat contained per unit (mass times heat capacity)]. Proportional to the kinetic energy of the molecular motions.

T*, T-Star: Characteristic mean temperature gradient. Atmospheric stability expressed in terms of the vertical temperature gradient per log of height ($\partial T/\partial(\ln z)$, where z is the height above the ground). Used as a measure of thermal turbulence, which varies inversely with T*. Stability varies directly with T* (when offset by a constant representing the dry adiabatic lapse rate).

Trajectory: The path of a particle or parcel downwind (away from the wind direction) over a given time period. (During WXGRAPH, trajectories start at the position of origin and travel downwind. Not to be confused with an instantaneous snapshot of a plume.)

U*, U-Star: Friction velocity. Modified horizontal wind speed shear per log of height ($\partial U/\partial(\ln z)$, where z is the height above the ground). U-Star increases as mechanical turbulence decreases.

Vector: An arrow drawn to represent the motion of the wind, the trajectory of a parcel, or another directional quantity. A wind vector points in the opposite direction from the wind direction as reported.

Warm boot (also called "reboot"): Restarting the computer while leaving the main power supply turned on. On an IBM PC/AT or XT, this is done by striking the <Ctrl>, <Alt>, and <Del> keys simultaneously. (Although the power remains on, all RAM memory is erased.)

WD, WDir: Wind direction--the direction <u>from</u> which the wind is blowing. [Wind arrows, or wind vectors, in the CHAWS graphic display (WXGRAPH) point <u>downwind</u>--i.e., in the direction of travel of airborne material and opposite the wind direction.]

WS, WSpd: Wind speed--the speed with which the air is blowing past a point. A 5-minute average represents the average speed of all the air parcels that pass a point in the 5-minute period.

ZERO: The reference value displayed on an air-quality analyzer to monitor the low end of the operational range during calibration.

Appendix I-B: Unit Definitions and Conversions

Parameter (abbrev.)	Definition	Units (abbrev.)	Conversion	Units
CONCENTRATION (Conc., X)	Volume or mass of air pollutant per volume of air	Parts per billion by volume (ppbv)	(none needed)	
SIGMA THETA (SigThe, $\sigma\Theta$)	Wind direction variation	Degrees (Deg, ^{o})	Modified sigma-theta method	Stability classes A - F
TEMPERATURE (Temp, T)	Heat per unit (mass x heat capacity) of air	Degrees Centigrade (^{o}C)	X 9/5 + 32 =	Degrees Fahrenheit (^{o}F) -20^{o}C= -4^{o}F -10^{o}C= 14^{o}F 0^{o}C= 32^{o}F 10^{o}C= 50^{o}F 20^{o}C= 68^{o}F 30^{o}C= 86^{o}F 40^{o}C=104^{o}F
WIND DIR'N (Wdir, WD)	Direction from which wind blows	Degrees (Deg, ^{o})	90/ per cardinal wind direction	0^{o}=North 90^{o}=East 180^{o}=South 270^{o}=West
WIND SPEED (Wspd, WS)	Speed of air past station	meters per sec (m/s)	X 2.237 =	miles per hr (mi/hr or mph)

Appendix I-C: Julian Calendar

Version I (non-leap year)

DAY OF MON	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DAY OF MON
						Julian Date (MONTH)							
1	1	32	60	91	121	152	182	213	244	274	305	335	1
2	2	33	61	92	122	153	183	214	245	275	306	336	2
3	3	34	62	93	123	154	184	215	246	276	307	337	3
4	4	35	63	94	124	155	185	216	247	277	308	338	4
5	5	36	64	95	125	156	186	217	248	278	309	339	5
6	6	37	65	96	126	157	187	218	249	279	310	340	6
7	7	38	66	97	127	158	188	219	250	280	311	341	7
8	8	39	67	98	128	159	189	220	251	281	312	342	8
9	9	40	68	99	129	160	190	221	252	282	313	343	9
10	10	41	69	100	130	161	191	222	253	283	314	344	10
11	11	42	70	101	131	162	192	223	254	284	315	345	11
12	12	43	71	102	132	163	193	224	255	285	316	346	12
13	13	44	72	103	133	164	194	225	256	286	317	347	13
14	14	45	73	104	134	165	195	226	257	287	318	348	14
15	15	46	74	105	135	166	196	227	258	288	319	349	15
16	16	47	75	106	136	167	197	228	259	289	320	350	16
17	17	48	76	107	137	168	198	229	260	290	321	351	17
18	18	49	77	108	138	169	199	230	261	291	322	352	18
19	19	50	78	109	139	170	200	231	262	292	323	353	19
20	20	51	79	110	140	171	201	232	263	293	324	354	20
21	21	52	80	111	141	172	202	233	264	294	325	355	21
22	22	53	81	112	142	173	203	234	265	295	326	356	22
23	23	54	82	113	143	174	204	235	266	296	327	357	23
24	24	55	83	114	144	175	205	236	267	297	328	358	24
25	25	56	84	115	145	176	206	237	268	298	329	359	25
26	26	57	85	116	146	177	207	238	269	299	330	360	26
27	27	58	86	117	147	178	208	239	270	300	331	361	27
28	28	59	87	118	148	179	209	240	271	301	332	362	28
29	29		88	119	149	180	210	241	272	302	333	363	29
30	30		89	120	150	181	211	242	273	303	334	364	30
31	31		90		151		212	243		304		365	31
DAY OF MON	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DAY OF MON

Appendix I-C: Julian Calendar (cont'd)

Version II (leap year)

DAY OF MON	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DAY OF MON
	MONTH — Julian Date												
1	1	32	61	92	122	153	183	214	245	275	306	336	1
2	2	33	62	93	123	154	184	215	246	276	307	337	2
3	3	34	63	94	124	155	185	216	247	277	308	338	3
4	4	35	64	95	125	156	186	217	248	278	309	339	4
5	5	36	65	96	126	157	187	218	249	279	310	340	5
6	6	37	66	97	127	158	188	219	250	280	311	341	6
7	7	38	67	98	128	159	189	220	251	281	312	342	7
8	8	39	68	99	129	160	190	221	252	282	313	343	8
9	9	40	69	100	120	161	191	222	253	283	314	344	9
10	10	41	70	101	131	162	192	223	254	284	315	345	10
11	11	42	71	102	132	163	193	224	255	285	316	346	11
12	12	43	72	103	133	164	194	225	256	286	317	347	12
13	13	44	73	104	134	165	195	226	257	287	318	348	13
14	14	45	74	105	135	166	196	227	258	288	319	349	14
15	15	46	75	106	136	167	197	228	259	289	320	350	15
16	16	47	76	107	137	168	198	229	260	290	321	351	16
17	17	48	77	108	138	169	199	230	261	291	322	352	17
18	18	49	78	109	139	170	200	231	262	292	323	353	18
19	19	50	79	110	140	171	201	232	263	293	324	354	19
20	20	51	80	111	141	172	202	233	264	294	325	355	20
21	21	52	81	112	142	173	203	234	265	295	326	356	21
22	22	53	82	113	143	174	204	235	266	296	327	357	22
23	23	54	83	114	144	175	205	236	267	297	328	358	23
24	24	55	84	115	145	176	206	237	268	298	329	359	24
25	25	56	85	116	146	177	207	238	269	299	330	360	25
26	26	57	86	117	147	178	208	239	270	300	331	361	26
27	27	58	87	118	148	179	209	220	271	301	332	362	27
28	28	59	88	119	149	180	210	221	272	302	333	363	28
29	29	60	89	120	150	181	211	242	273	303	334	364	29
30	30		90	121	151	182	212	243	274	304	335	365	30
31	31		91		152		213	244		305		366	31
DAY OF MON	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DAY OF MON

Chapter II

REWIRED HANDAR INSTRUMENTS AND TOWERS

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1.0 INTRODUCTION

This chapter of the CHAWS User's Guide is devoted to the electronic configuration of HANDAR instruments that were modified by Lawrence Livermore National Laboratory (LLNL) personnel. Because unmodified HANDAR instruments are described in detail in the HANDAR manuals, we do not repeat the details of these instruments in this chapter. Please consult the HANDAR manuals for descriptions of the hardware used for meteorological data collection. Copies of the appropriate manuals have been provided to each CHAWS site.

The HANDAR system consists of a variety of instruments for measuring the following meteorological parameters: temperature, wind direction, wind speed, and relative humidity. The sensors that detect these parameters are described in detail in their respective HANDAR manuals. However, at each CHAWS site, a few of the instruments have been rewired by LLNL personnel to configure the towers for their unique instrumentation. Wiring diagrams for these unique configurations are provided in Appendix II-A so that maintenance and troubleshooting can be performed. Some of the CHAWS systems also contain AQ sensors and a SODAR system, which are described in detail in UCID-20988 and Chapter III, respectively.

The rewired instruments for the Pine Bluff site are as follows:

- 60-m tower, single level and five-level.
- 60-m tower, single- and five-level air quality.
- Solar panel wiring.
- 26-pin connector wiring.

These systems have been rewired and are unique to the site. The wiring diagrams for these systems are presented in Figures II-1 through II-5, Appendix II-A. We use the same terminology (connection numbers and letters) as used in the HANDAR manuals to avoid confusion. Appendix II-A also contains a glossary of abbreviations used in the diagrams.

2.0 SITE CONFIGURATION

To adequately characterize atmospheric dispersion throughout the Pine Bluff site, it was necessary to construct a number of meteorological towers around the site, as well as two multilevel towers. The purpose of this pattern is to depict local variations in wind and stability caused by local effects. A REMTECH SODAR unit (described in Chapter III) is also being installed for this reason.

The meteorological sensors are briefly described below. More detailed information and calibration procedures are given in the manuals for the respective instruments.

2.1 Tower and sensor configuration

Each of the seven towers at Pine Bluff is 60 m tall, with sensors at the top (called level 6) for wind direction and standard deviation of wind direction (sigma theta), wind speed, and temperature. The three towers that have only these sensors are called Type 1. Two more single-level towers that have additional sensors for AQ monitoring are called "Type 2."

Two multilevel towers, Towers 1 and 6, have sensors at level five (30 m); the one that does not contain AQ sensors is referred to as Type 3; the one with AQ sensors is Type 4. A configuration similar to that of the Type 1 stations exists at the top three levels on these towers--15, 30, and 60 m (levels 4, 5, and 6). In addition, both temperature and relative humidity are measured at 3.8 and 7.5 m (levels 2 and 3). The five temperature levels on these towers permit a reliable calculation of the temperature profile (T*, temperature gradient with the log of the height above ground), while relative humidity is observed at two levels only for redundancy.

In addition to locating the tall meteorological towers at the Pine Bluff site, the vertical structure of atmospheric wind and turbulence above 60 m can be characterized using the SODAR system. One REMTECH SODAR unit will be strategically located to monitor the change in the mixing layer during the day.

2.2 Meteorological sensor description

Each Type 1 tower configuration includes a 3-cup anemometer, horizontal wind direction vane, and thermistor (HANDAR Models 430A, 431A, and 433A, respectively). The HANDAR software calculates sigma theta from wind direction fluctuations. Temperature and relative humidity sensors are combined at the lower two levels of towers 1 and 6 (Types 3 and 4) in a HANDAR Model 435A dual sensor. AQ sensors have been added to towers 1, 3, 4, and 7 (Types 2 and 4).

All instrumentation sensor models have been approved by the Environmental Protection Agency (EPA) and the U.S. Nuclear Regulatory Commission (NRC) for prevention of significant deterioration (PSD) monitoring and other environmental licensing purposes. Each temperature and humidity sensor is protected by an inverted, triple-conical, naturally aspirated, radiation shield.

The SODAR system operates by sending strong sound pulses (about 120 dB) upward. Two pulses travel horizontally at angles perpendicular to each other, yet each is offset by only 18 degrees from the vertical. A third pulse travels directly upward. Two nearly adjacent sound frequencies are used--1600 and 1610 Hz--to minimize ambient noise interfering with the system. Atmospheric eddies reflect a very small portion of the sound, at a frequency offset by a ratio twice that of the speed of the eddies (to or away from the receiver) to the speed of sound. To receive reflected sound pulses, each of the three pulse transmitters becomes a receiver shortly after the pulse is transmitted.

The microprocessor derives the three orthogonal components of wind speed using the difference between the transmitted and received SODAR frequencies. It uses a Fourier transform technique to help filter out ambient noise. This advanced system even adjusts the calculations for changes in the speed of sound according to local air temperature at the unit.

3.0 DATA-ACQUISITION SYSTEM

Each of the seven monitoring stations contains a HANDAR 540A data collection platform (DCP), which stores data collected from the tower. Summaries of these data are transmitted via radio telemetry to the base station at regular intervals.

Wind direction data are sampled every second to obtain an adequate number of values (300) for sigma theta. Wind speed, temperature, and humidity are sampled every 10 seconds. The HANDAR software averages wind values and calculates sigma theta every 5 minutes and averages temperature and humidity values every 15 minutes.

The data channels, station types, and station configurations are summarized by channel in Tables II-1 through II-3.

Table II-1. HANDAR 540A DCP Channel configuration list for the Pine Bluff site.

Chan. No.	Description
1	Battery voltage
2	Air quality, signal
3	Air quality, NO
7	Air quality, O_3
8	Air quality, SO_2
9	Air quality, NO_x
26	Temp., level 2 (^oC) (3.8m)
36	Temp., level 3 (^oC) (7.5m)
46	Temp., level 4 (^oC) (15m)
56	Temp., level 5 (^oC) (30m)
66	Temp., level 6 (^oC) (60m)
28	Humidity, level 2 (%) (3.8m)
38	Humidity, level 3 (%) (7.5m)
41	Wind speed, level 4 (m/s)
51	Wind speed, level 5 (m/s)
61	Wind speed, level 6 (m/s)
43	Wind direction, level 4 (deg.)
53	Wind direction, level 5 (deg.)
63	Wind direction, level 6 (deg.)
44	Standard dev. of wind direction, level 4
54	Standard dev. of wind direction, level 5
64	Standard dev. of wind direction, level 6

Table II-2. Placement of station types.

Type	Station numbers
1	4, 5,
2	2, 3, 7
3	6
4	1

Table II-3. Station type configuration of channels.

Type 1	
1	Battery voltage
61	Wind speed, level 6 (m/s)
63	Wind direction, level 6 (deg.)
64	Standard dev. of wind direction, level 6
66	Temp., level 6 (^{o}C)
Type 2	
1	Battery voltage
2	Air quality, signal
3	Air quality, NO
7	Air quality, O_3
8	Air quality, SO_2
9	Air quality, NO_x
61	Wind speed, level 6 (m/s)
63	Wind direction, level 6 (deg.)
64	Standard dev. of wind direction, level 6
66	Temp., level 6 (^{o}C)
Type 3	
1	Battery voltage
26	Temp., level 2 (^{o}C)
28	Humidity, level 2 (%)
36	Temp., level 3 (^{o}C)
38	Humidity, level 3 (%)
41	Wind speed, level 4 (m/s)
43	Wind direction, level 4 (deg.)
44	Standard dev. of wind direction, level 4
46	Temp., level 4 (^{o}C)
51	Wind speed, level 5 (m/s)
53	Wind direction, level 5 (deg.)
54	Standard dev. of wind direction, level 5
56	Temp., level 5 (^{o}C)
61	Wind speed, level 6 (m/s)
63	Wind direction, level 6 (deg.)
64	Standard dev. of wind direction, level 6
66	Temp., level 6 (^{o}C)

Table II-3. Station type configuration of channels (cont'd.).

Type 4 (Note: type 4 combines type 2 and 3 stations as grouped below.)

1	Battery voltage
2	Air quality, signal
3	Air quality, NO
7	Air quality, O_3
8	Air quality, SO_2
9	Air quality, NO_x
26	Temp., level 2 (^oC)
28	Humidity, level 2 (%)
36	Temp., level 3 (^oC)
38	Humidity, level 3 (%)
41	Wind speed, level 4 (m/s)
43	Wind direction, level 4 (deg.)
44	Standard dev. of wind direction, level 4
46	Temp., level 4 (^oC)
51	Wind speed, level 5 (m/s)
53	Wind direction, level 5 (deg.)
54	Standard dev. of wind direction, level 5
56	Temp., level 5 (^oC)
61	Wind speed, level 6 (m/s)
63	Wind direction, level 6 (deg.)
64	Standard dev. of wind direction, level 6
66	Temp., level 6 (^oC)

Appendix II-A: Rewired Instruments and Glossary

Glossary

O_3	- ozone	DCP	- data collection platform
SO_2	- sulfur dioxode	Batt	- battery
NO	- nitric oxide	NO_x	- oxides of nitrogen
RH	- relative humidity	CALSIG	- calibration signal
BP	- barometric pressure	WDSW	- wind direction, wind speed
GND	- ground	WDSIG	- wind direction signal
WS	- wind speed	Temp	- temperature
WD	- wind direction	Met	- meteorology
WT	- weight	TS	- terminal strip
ST	- station	CH	- channel
Sig	- signal	T1	- temperature 1
T2	- temperature 2	T3	- temperature 2
TB1	- terminal block 4	TB3	- terminal block 3
TB5	- terminal block 5	TB7	- terminal block 7
SW	- switch	NC	- no correction

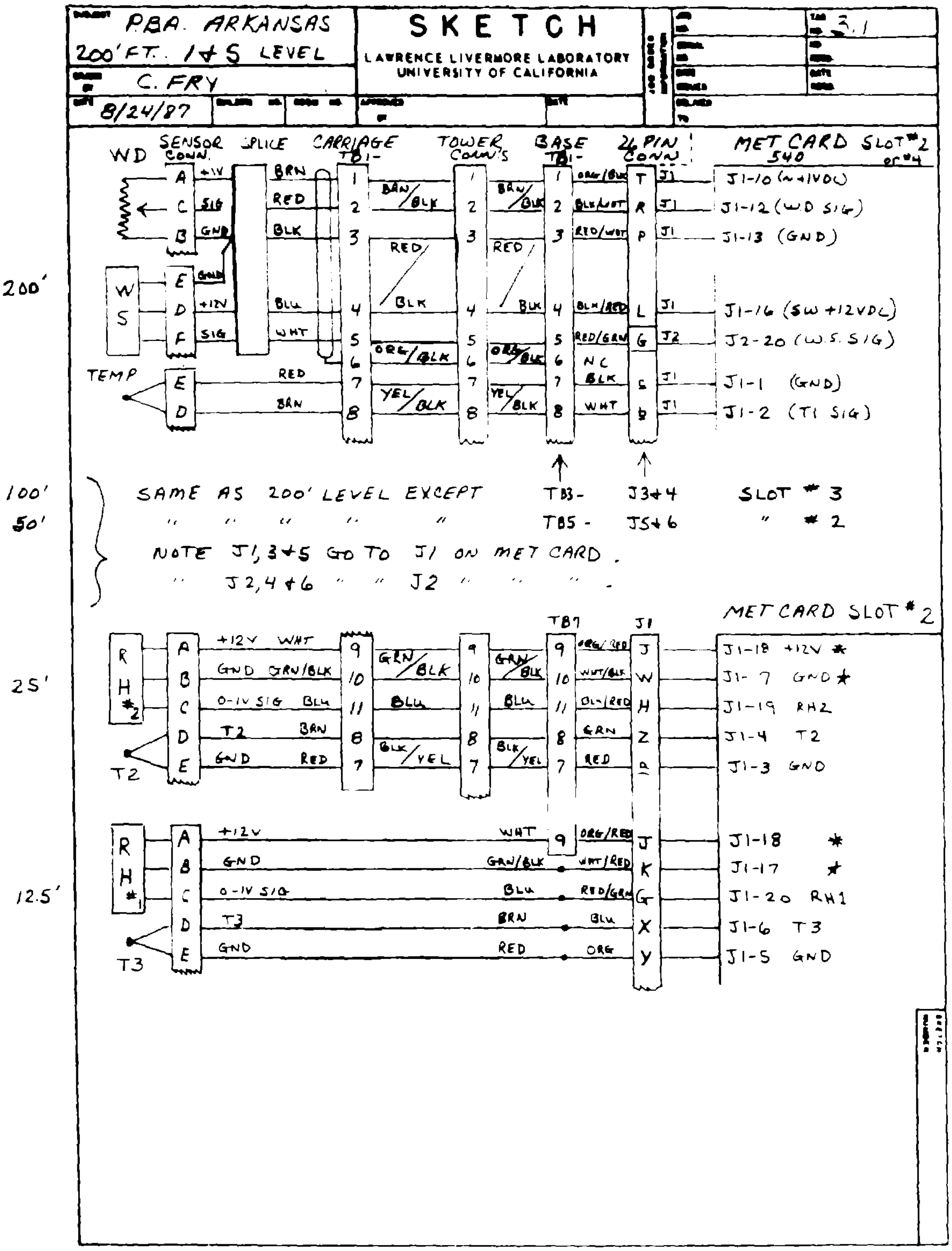


Figure II-1. Wiring diagram of single- and multi-level 60-m towers.

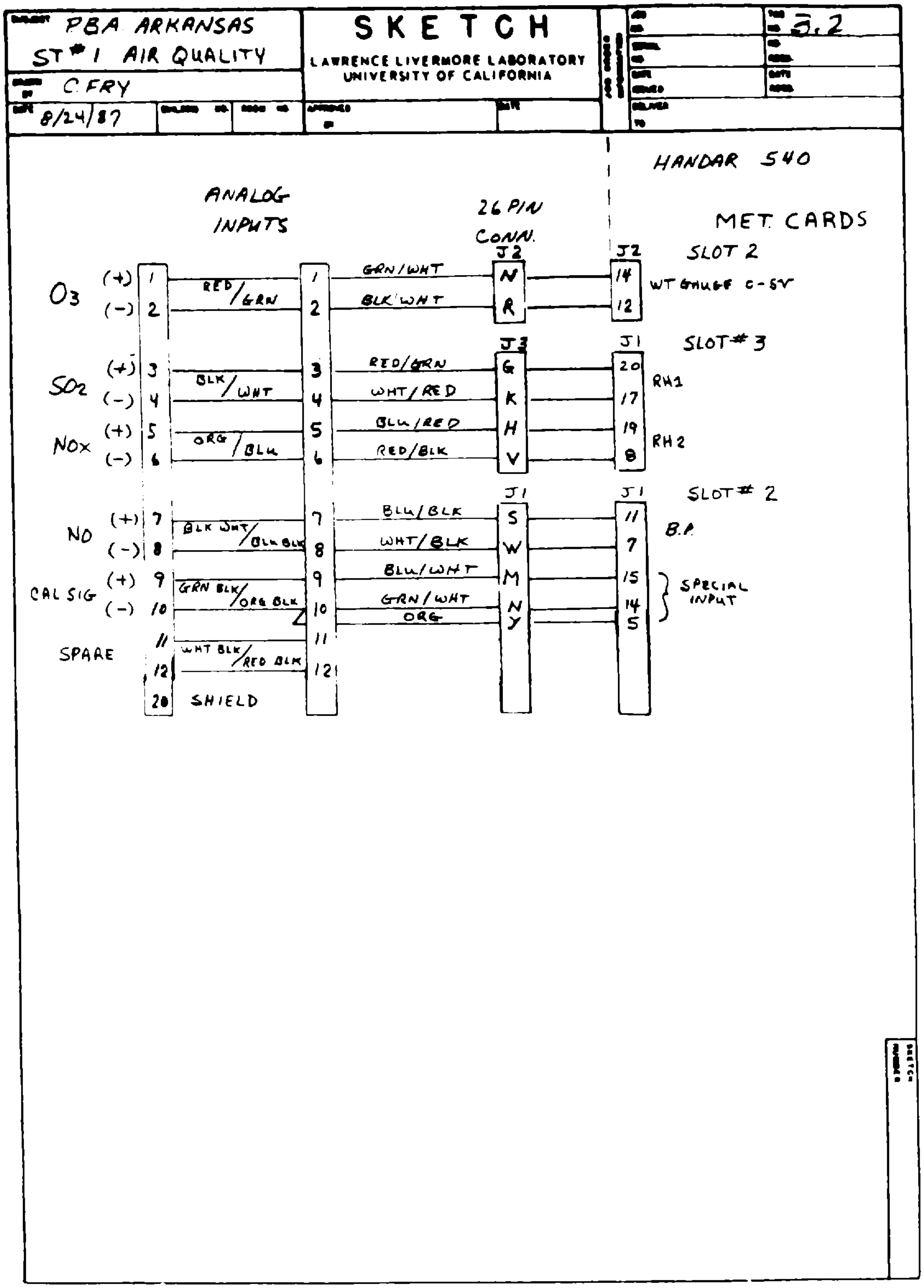


Figure II-2. Wiring diagram of air quality sensors at station 1.

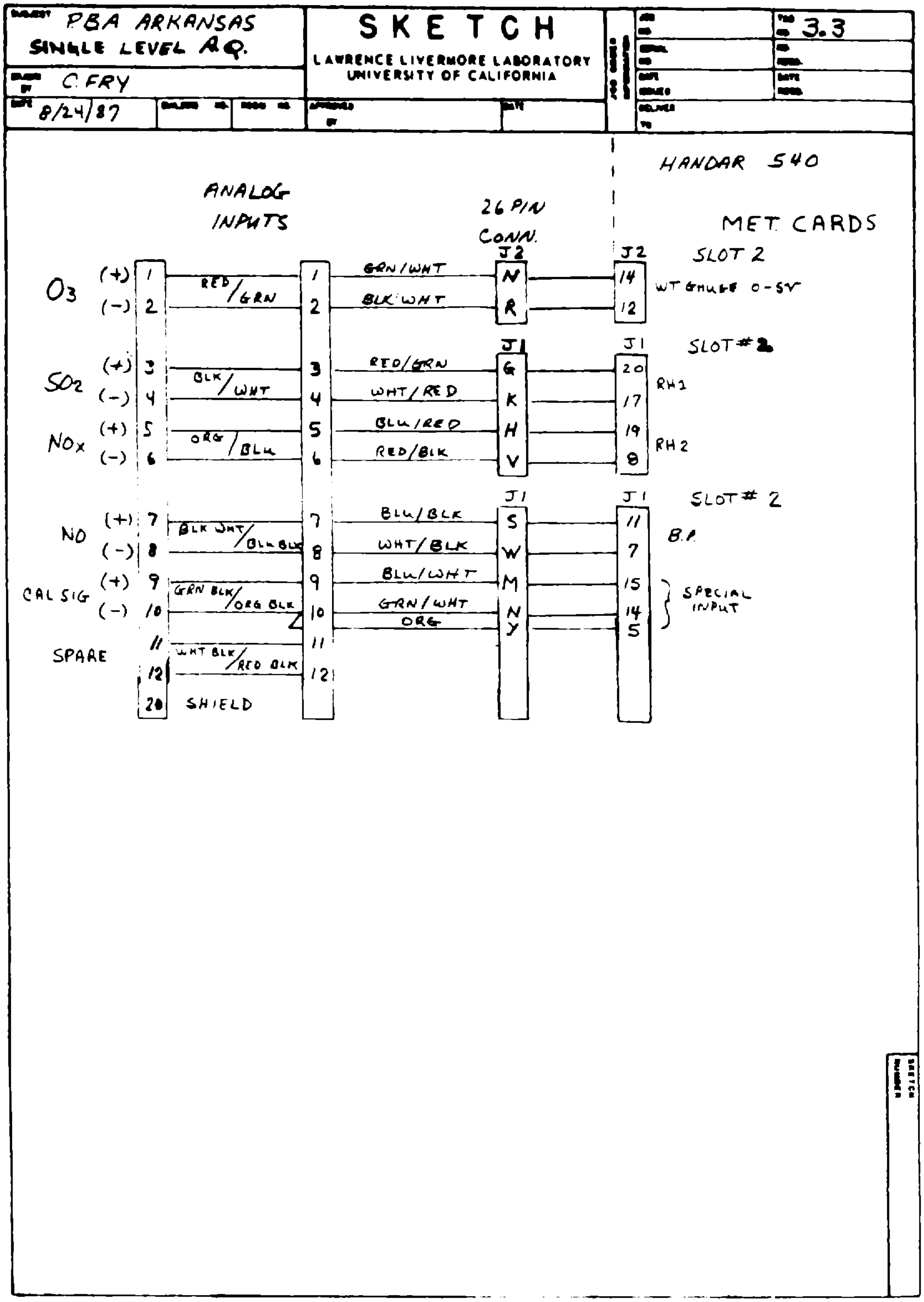


Figure II-3. Wiring diagram of air quality sensors on single-level towers.

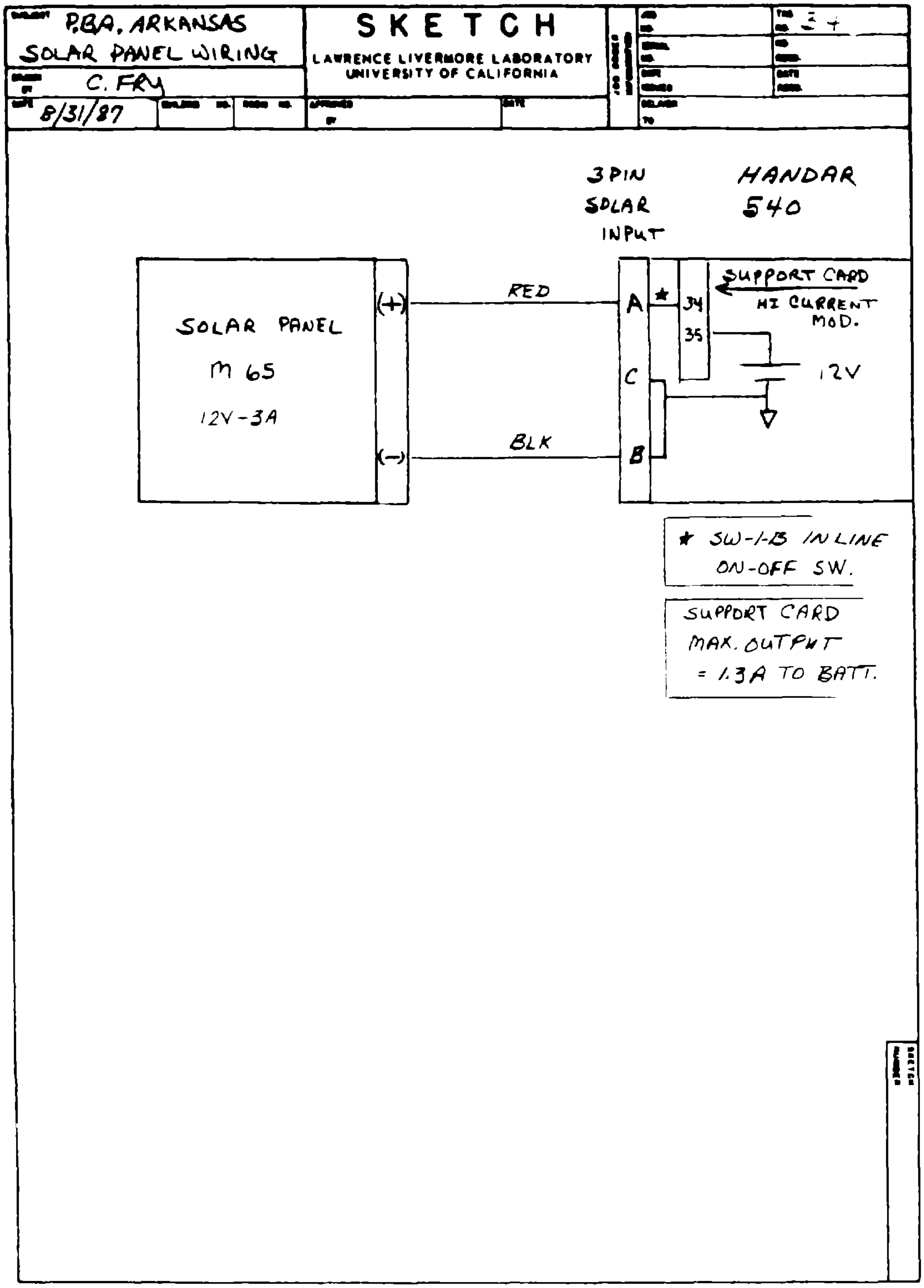


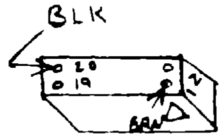
Figure II-4. Wiring diagram of solar panels.

PBA ARKANSAS 26 PIN CONNECTOR	**SKETCH** LAWRENCE LIVERMORE LABORATORY UNIVERSITY OF CALIFORNIA	3.5
C. FRY		
8/21/87		

TERMINAL STRIPS (NOTE ALL WIRED THE SAME)

	26 PIN CONN		METCARD PIN
BLK	c	BRN	1
WHT	b	RED	2
RED	a	ORG	3
GRN	Z	YEL	4
ORG	Y	GRN	5
BLU	X	BLU	6
WHT/BLK	W	VIO	7
RED/BLK	V	GRY	8
GRN/BLK	U	WHT	9
ORG/BLK	T	BLK	10
BLU/BLK	S	BRN	11
BLK/WHT	R	RED	12
RED/WHT	P	ORG	13
GRN/WHT	N	YEL	14
BLU/WHT	M	GRN	15
BLK/RED	L	BLUE	16
WHT/RED	K	VIO	17
ORG/RED	J	GRAY	18
BLU/RED	H	WHT	19
RED/GRN	G	BLK	20

NC → FEDCBA



ORG/GRN
BLK/WHT/RED
WHT/BLK/RED
RED/BLK/WHT
GRN/BLK/WHT
ORG/BLK/WHT

} NOT USED CUT OFF

Figure II-5. Wiring diagram of 26-pin connector.

Chapter III
SOUND DETECTION AND RANGING (SODAR) SYSTEMS

Ken Lamson
Stan Martins
Michael Novo
Environmental Sciences Division

1.0 SYSTEM OVERVIEW

Monostatic Doppler sound detection and ranging (SODAR) systems, REMTECH Model BA23A, have been installed at the Pine Bluff and Edgewood sites. These systems are able to detect certain meteorological parameters above 60 m, which is the height of the tallest meteorological towers installed at these sites.

A SODAR system measures, at heights of up to 1000 m, wind speed and direction, vertical motions, turbulence, and thermal structure, allowing the inference of mixing depths. This measurement is accomplished by emitting dual strong acoustic pulses in the audio band (approximately 1600 Hz) and detecting the Doppler frequency shift of the received backscattered echo. This backscattered echo signal is caused by thermal turbulence in the atmosphere. The signal frequency shift (Doppler shift) and its relative strength are processed in various ways to produce far more information than previously available through conventional methods such as instrumented towers, tethersondes, etc.

The three-dimensional, monostatic, Doppler SODAR system (Fig. III-1) basically consists of three co-located antennae with high-power sound drivers. Two of the antennae are tilted 18 degrees from the vertical and turned 90 degrees from each other and provide the horizontal information. Each antenna is operated in a sequence and at a rate completely controlled by the software program of the system, which may be changed through keyboard input. The standard electronic complement of the system includes a power amplifier, a transceiver, a dual floppy-disk drive, and a printer or CRT terminal with keyboard, all controlled by a Digital Equipment Corporation (DEC) PDP 11/23 microcomputer. All these system components, except the printer or CRT terminal, are mounted in a standard 19-in. equipment rack approximately 4.5 ft high. The control and recording equipment require an environmentally controlled operating location, such as a building or trailer, maintained at a temperature of $20^{\circ}C \pm 5^{\circ}C$. For permanent installation, the antennae and their integral enclosures can be mounted on concrete pads approximately 100 m from the data-acquisition equipment building. Where system mobility is a requirement, the antennae can be mounted on a trailer, as is being done for the CHAWS system.

A major advantage of the REMTECH SODAR system is its tremendous user flexibility. Virtually all important parameters, such as averaging and sampling times, transmitting power, antenna orientation, pulse length, range gates, and maximum range are operator selectable by simple key-in options to the PDP 11/23 microcomputer.

2.0 OPERATIONS GUIDE

This section describes the operations necessary, and the frequency of their occurrence, that ensure that the system is operating correctly. It also describes simple measures that will help in preventive maintenance so that the system is kept running, with accurate data collection.

2.1 Daily

2.1.1 On arrival

Check to see that the SODAR data have been collected for each 15-minute interval by the Emergency Operations Center (EOC) SODAR data computer.

2.1.2 During the day

Check to see that EOC SODAR data computer is collecting the SODAR data for each 15-minute interval. The telecommunications software module automatically handles SODAR data logging (see Section 4 and CHAWS Computer System, Chapter V, Sections 2.4, 3.4, and Appendix V-B).

2.2 Periodically

2.2.1 Twice weekly

Visit the SODAR site and do the following:

a. Check the shelter air conditioner.

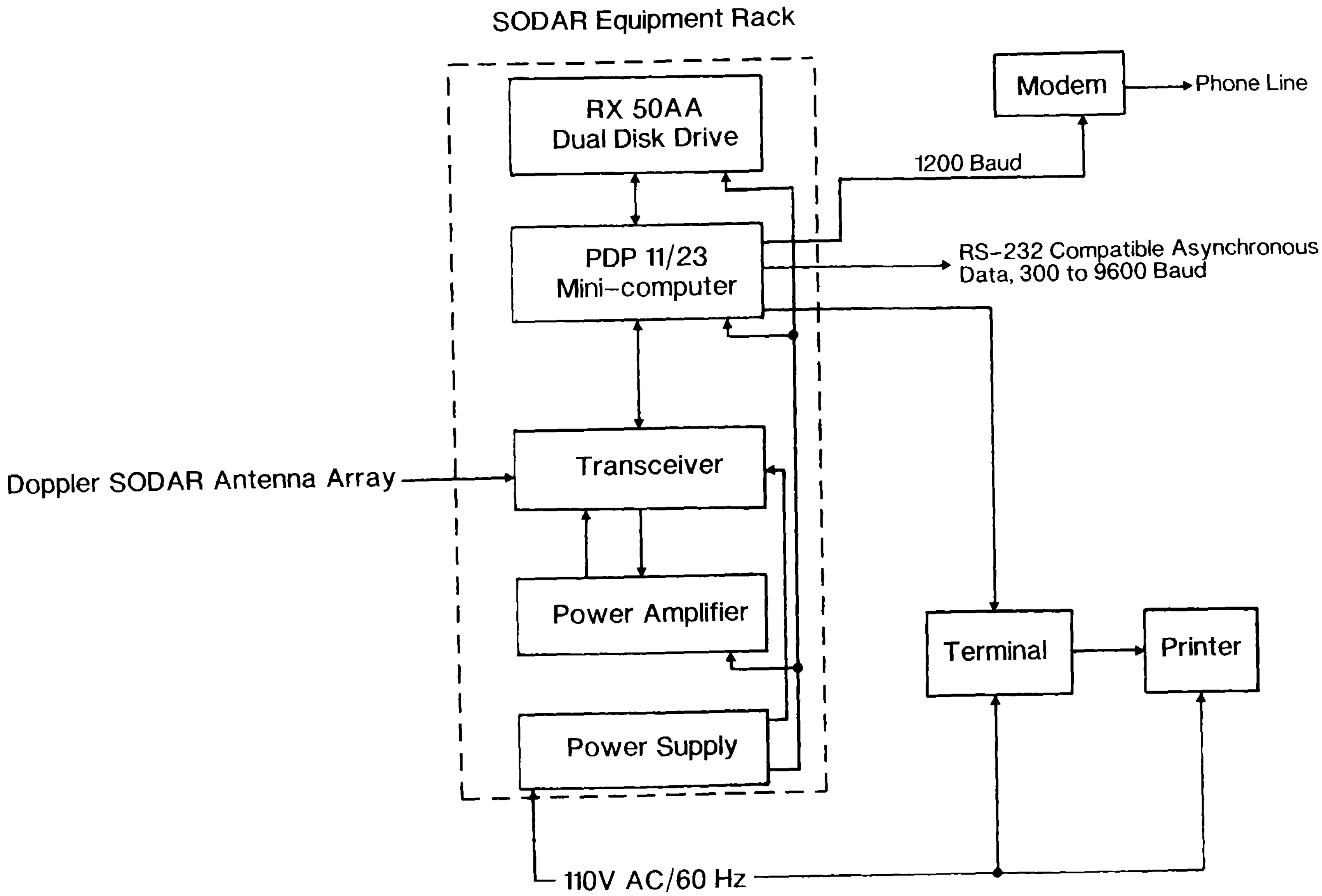


Figure III-1. Doppler SODAR block diagram.

b. Check the antenna calibration for each of the antennae (consult the SODAR manual). A negative sign in front of an individual antenna calibration result indicates failure of that antenna channel, either electrical (cabling or driver coil) or acoustical (driver diaphragm, acoustic antenna shelter).

2.2.2 Monthly

Visit the SODAR site and do the following:

a. Inspect all the antenna cables, equipment rack, and antenna shelters.

b. Open each antenna shelter access door and visually inspect the interior, drivers, and driver connections.

c. Check that the trailer is level; adjust as necessary.

3.0 SYSTEM HARDWARE

The REMTECH SODAR system consists of several pieces of hardware. The major components of the system and their uses are described below:

- DEC PDP 11/23 computer with 256k RAM, four RS232 ports, 16 differential inputs into 12-bit A/D multiplexed converter, 16-bit parallel interface and bootstrap proms.
- DEC RX50 floppy-disk drive for system operations.
- DEC RX50 floppy-disk drive for storage of processed SODAR data.
- DEC VT220 video terminal and keyboard.
- DEC LA50 printer.
- Byston 4B acoustical power amplifier.
- Transceiver module, interface between PDP 11/23 computer and 4B power amplifier (Fig. III-2).
- Hayes 300/1200-baud modem.
- External surge protector for the computer, floppy-disk drives, transceiver, acoustic power amplifier, printer, video terminal-keyboard, modem 110-V ac line, and modem telephone line.
- Three 100-m MU-metal shielded antenna cables (special).

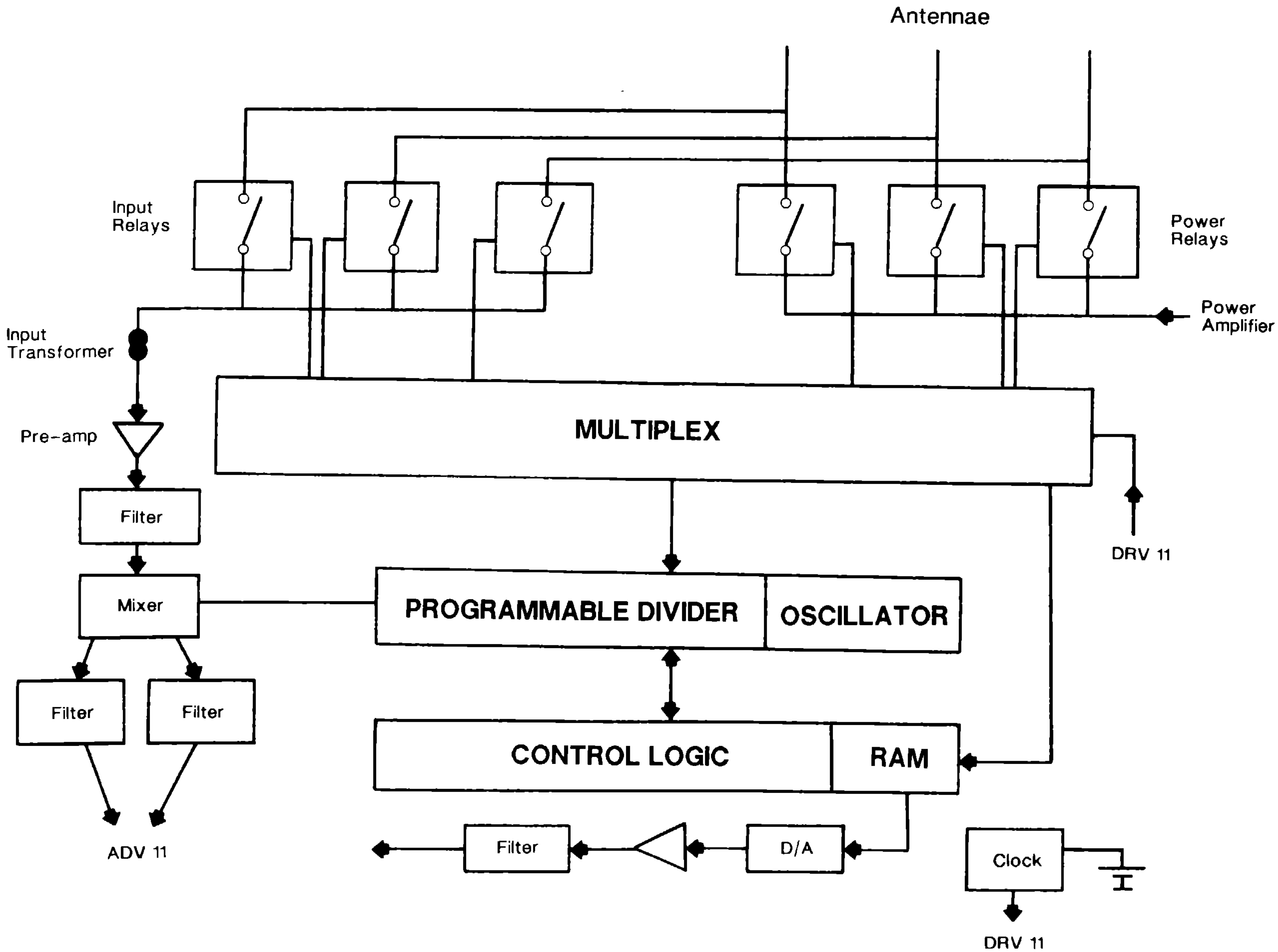


Figure III-2. Schematic of the SODAR transceiver.

- Three acoustic antenna fiberglass enclosures lined with high-density acoustic foam (Fig. III-3).
- 8-ft by 20-ft antenna trailer.
- Three JBL 2445J high-power acoustic compression drivers with transition cones.
- Three antenna heaters: devices that prevent ice buildup on the interior of the antenna enclosures.

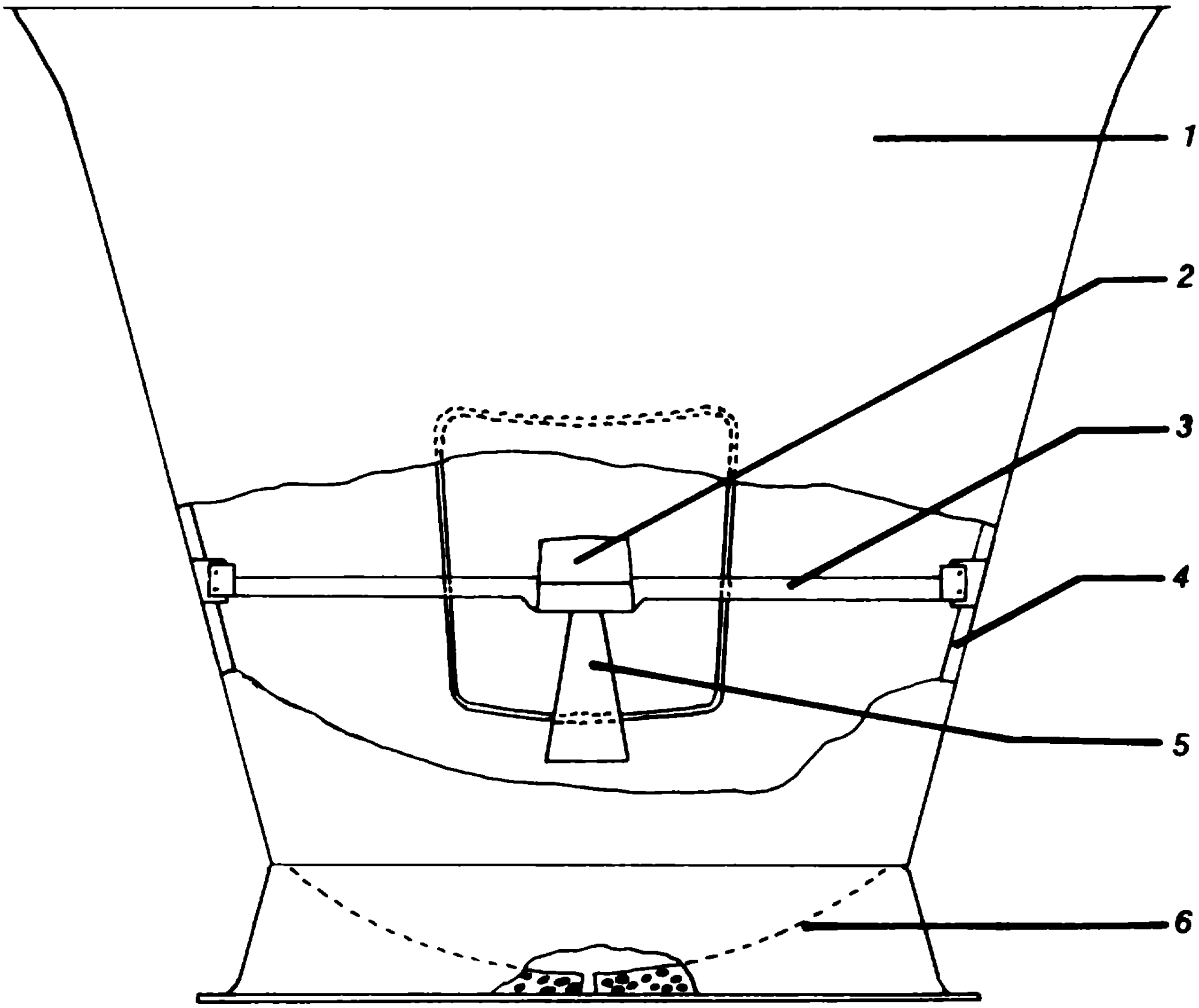
The antenna system and heaters are mounted on the antenna trailer located 100 m from the computer components, which are housed in a temperature-controlled, weatherproof, 8x8x8-ft shelter. Alternating-current power and a phone line are supplied to the shelter.

4.0 SODAR SYSTEM SOFTWARE

The SODAR system is designed to work automatically and to produce reliable data that does not require interpretation by a specialist. The SODAR program runs on a DEC PDP 11/23 under the RT11 operating system. The operating system and SODAR program are stored on the system floppy disk and are loaded automatically in the RAM of the computer when it is switched on, or after a power failure. Booting is automatic and does not require an operator.

The SODAR program is written partly in FORTRAN and partly in MACRO assembly language. REMTECH provides this program only in object-code form. A flow diagram of the software operation is shown in Figure III-4. Briefly, the SODAR software performs the following tasks:

- Management of I/O.
- Management of electronic transceiver.
- Software diagnostics for filter, gain, noise and transfer function.
- Antenna temperature compensation.
- Fixed echo detection.
- Fast Fourier transform Doppler detection by software.
- Extraction of wind components from spectra.
- Standard display and recording of date, time, number of valid returns, echo strength, wind speed and direction, vertical wind speed, and fixed echo output for each antenna.
- Automatic real-time data validation.
- Data output to floppy disk and printer.



1 Fiberglass antenna enclosure
2 Driver rain cap
3 Driver support arm
4 Acoustic foam
5 Driver transition section
6 Acoustic reflector

Figure III-3. Antenna cross-section drawing.

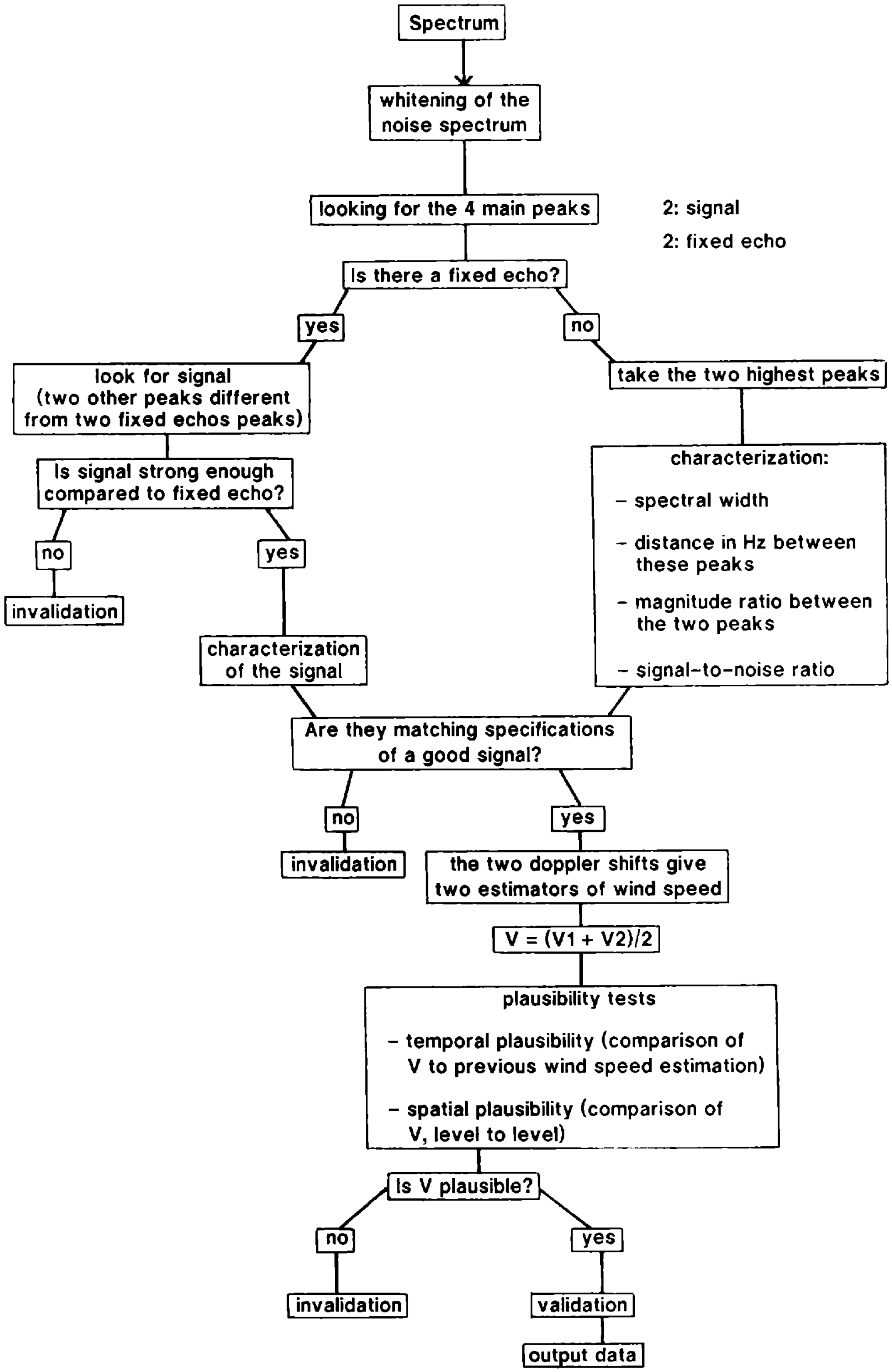


Figure III-4. Flow diagram of software operations.

- Optional real-time application software such as automatic detection of temperature inversions.

The SODAR software is made up of a main program and of specific-task subroutines. Part 1 of the main program is executed only once when the SODAR program is loaded. The following subroutines are called:

- FILES - checks to see if a previous data file exists on tape or floppy disk. If it exists, the file is opened; if not, it creates and opens a new one.
- INIT - performs initialization procedures such as setting operating parameters to their correct values (reading SODCON.INI), restoring date and time by reading the hardware clock, computing shape of pulse, etc.

Part 2 of the main program consists of an infinite loop, and each time around, the following operations are performed on one antenna:

Emission
Reception
Signal processing
Determination of instantaneous wind speed

This loop is interrupted at given times for special operations such as antenna calibration or averaging period computations. At each completion of the loop, the following subroutines are called:

- CONSOL - manages I/O between computer and terminals (example: changing a parameter value from the master console).
- INIT2 - performs initialization procedures for parameters that can vary from one pulse to another.
- SODINT - (written in MACRO assembly language) used for driving the SODAR electronic transceiver and performs processes such as the following:
  frequency generation by addressing a programmable divider
  relay sequencing
  signal mixing by emission frequency
  signal sampling
- FFT - computes a Fast Fourier transform on 32 complex points and gives spectral density on 32 frequency points for each layer. (20 FFT are computed if the number of slices is set to 20.)
- PR - analyzes a spectrum and tries to extract wind speed at each layer for each antenna. It also has special outputs available through the RS232, such as spectrum visualization.

- SMI - computes averages and standard deviation. These values are not computed at the end of an averaging period but are continuously updated after each pulse.
- SERVIC - services the software modules.

The following subroutines are called at specific times:

- CALIB - performs a calibration procedure. Based on a user-selected interval, typically every 2 or 3 hours, a white noise is emitted to obtain the transfer function of the antenna, and an optimum emission frequency is determined according to ambient noise and air temperature.
- PR - computes the instantaneous wind speed component obtained at different altitudes. These instantaneous values will be averaged to provide a mean value of wind speed for a given integration period. The determination of radial wind speed from the spectrum is performed by PR.
- INTEG - is called at the end of the averaging time and performs the final checking of results before they are output. This subroutine can also perform automatic detection of the temperature inversion (optional). The final tests performed by this subroutine are as follows:

  Ask at each layer and for each of the three components, for a minimum percentage of validations (percentage of cases where the system could extract a wind component).

  Ask for a reasonable value of the standard deviations of the three components. The idea is that a spurious point in wind-speed data produces a high standard deviation (the threshold value of standard deviation depends on turbulence conditions).

  Ask for a plausible wind profile.

If one of these final tests is negative, the software will invalidate the data at the incriminated layer.

4.1 Software diagnostics for local and remote testing

The final SODAR testing is handled completely by the PDP 11/23 and thus may be accessed from a remote location via modem and conventional phone line.

This allows automatic logic functions to test different parts of the system and display the results remotely. The diagnostic routines include the following:

- Test of filters including filter transfer function.
- Test of electronic gain.
- Test of electronic noise.
- Test of background noise including driver transfer function.
- Test for water, snow, or ice in the antennae.
- Print spectra received from any of the three antennae.

This testing capability is invaluable in the maintenance and troubleshooting of the system. All filter functions can be diagnosed. If noise problems develop, the particular source can be quickly identified.

4.2 SODAR telephone communications with the CHAWS system

4.2.1 Telephone protocols at CHAWS sites that have SODAR units

Telephone protocols are designed so that one telephone line can be used to poll the SODAR at 15-minute intervals and receive incoming calls the rest of the time. In addition to these main functions, other jobs may be assigned as well, on a site-by-site basis.

The SODAR data-collection software has been further modified so that Slave 3 does not reboot every 15 minutes. Rebooting was causing the system to hang up.

4.2.2 SODAR/telephone slave

When this slave is booted, it runs a program called MEX.COM (Modem Executive). This program reads a script file called SODAR.MEX, which causes the SODAR to be called and polled. The SODAR data are put into a file called SODAR.DAT and into a daily file with a name like 085_S87.DAT, where the first three numbers are the Julian date, S stands for SODAR data, and 87 is the year.

After the SODAR data have been logged, a secondary program called WAIT_ANS.EXE is run by MEX.COM. This causes the modem to be monitored for incoming calls. When the correct password is received through the modem, a file corresponding to this password is sent. These passwords and filenames are stored in a file called PASSWRD.CFG, which looks like this:

3	number of passwords
PBA or EDG	first password, site dependent
LATEST	second password
SODAR	third password
C:/HANDAR/TEMP1.DAT	first file
C:/LATEST/LATEST.DAT	second file
C:/SODAR/SODAR.DAT	third file

Communication parameters for this program are stored in a file called WAITCOM.CFG, which looks like this:

COM2	communications port used
1200	baud rate
,N,8,1,CSO,DSO,CDO	communication parameters
3	telephone slave number
MEX READ SODAR	files to execute at time-out

The modem is monitored until 1 minute past the next quarter hour, after which WAIT_ANS ends and MEX.COM resumes. The program then returns to the beginning of SODAR.MEX, and another call is issued to the SODAR unit.

5.0 MASTER CONSOLE USE

The following procedures should be followed to autoboot the system:

- Check that all the cables are connected between the components (video terminal, keyboard, printer, etc.).
- Ensure that the AC surge protectors have been installed for the rack, terminal, printer, and modem.
- Turn on the VT220 terminal and wait for the self-check to complete. The screen then displays the message "SYSTEM OK".
- Turn on the printer; then turn on the power amplifier.
- Open both disk doors.
- Turn on the computer.
- Install the system disk in the top drive (drive 0) and close the door.
- Install the data disk in the lower drive (drive 1) and close the door. After a few seconds, the system disk is read and the computer

automatically carries out the software-loading operation. The following lines then appear on the screen:

Screen	Explanation
RT-11SJ (S) V05.00	
ASSIGN DD0 (or DY0 or DU0) SF	Assign files
ASSIGN DD1 (or DY1 or DU1) SF	Assign files
INIT/NOQUERY VM	Initialize files
COPY DU0.G.SAV VM:	Copy files
Files copied:	
DU0:G.SAV to VM:G.SAV	Shows that the SODAR program is being loaded
RUN VM:G	The SODAR program has been loaded

After installing the SODAR program, the system waits. If there is no interruption by the operator, the system automatically starts working after 4 minutes. If the operator wishes to start the program without waiting for 4 minutes, he/she must type on the keyboard: go <Enter>.

The sequence of operations performed after GO (either automatic or manual) is as follows:

- Computer time set. Through the DRV11 serial interface board, the SODAR software reads the transceiver hardware clock and loads the corresponding time in the software clock of the DEC RT11 operating system.
- Read and load the operating parameters stored on the system diskette in drive 0.
- Read the data file on floppy-disk drive 1 and position the read/write head at the end of the last data block written.
- An automatic calibration procedure is performed that determines the optimal emission frequency for each antenna.

Once this sequence has finished, the SODAR is able to start normal functioning and begins to gather data.

6.0 SODAR ACOUSTIC THEORY

At times, the earth's atmosphere may appear to be very calm. One might think that there is no movement of air at all. This is rarely the case, however because there is generally a significant amount of activity in the atmosphere in the form of small-scale turbulence. This turbulence may be caused by either thermal activity or by mechanical sources. Thermal turbulence is the result of temperature differences, or gradients, in the atmosphere. Mechanical turbulence is caused by air movement. Because temperature gradients generally cause air movement, and air movement generates heat, one form of turbulence seldom occurs without the other. Turbulence created by either action will result in turbulent eddies that are quite small in size; they can be as small as 10 cm in diameter. Turbulent eddies in the size range of 10 to 20 cm are the ones of most interest when attempting to make measurements in the atmosphere using acoustic techniques.

When an acoustic (sound) pulse is transmitted up into the atmosphere, its energy is scattered when it reaches these turbulent eddies. The scattering pattern from thermal turbulence is different from that of mechanical turbulence. Figure III-5 illustrates the difference in the scattering patterns. These patterns hold true only if the turbulence is either totally thermal or totally mechanical. Because this is seldom the case, the pattern is going to be somewhere between the two. The energy that is backscattered (returned toward the source) is all that is of interest when making measurements using a monostatic system.

A lot of information about the atmosphere can be derived from this returned energy. After the backscattered energy is received by the antenna and is converted to an electrical signal, it can be analyzed to determine the stability of the atmosphere. However, when measuring air movement, the intensity of the returned energy is not critical as long as it is strong enough to be distinguished from the background noise. The shift in the frequency of the returned energy is what is important when measuring air movement. A shift in frequency indicates that the target (turbulent eddies at a given height) is moving either toward or away from the antenna. This shift in frequency is called the Doppler effect. If the target is moving toward the antenna, the frequency of the returned energy is higher than the frequency of the transmitted energy. Conversely, if the target is moving away from the

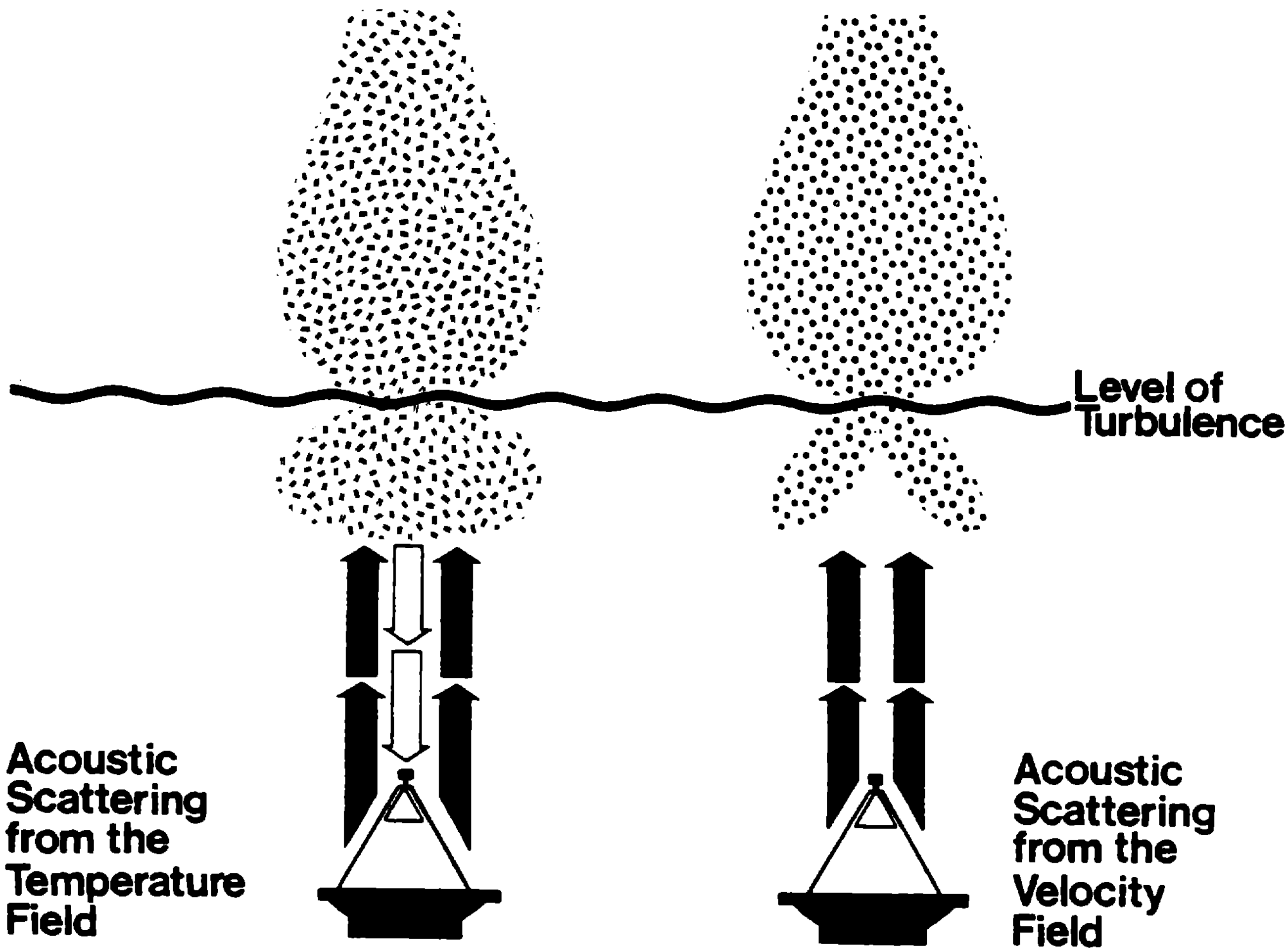


Figure III-5. SODAR acoustic scattering patterns.

antenna, the frequency of the returned energy is lower than the frequency of the transmitted energy.

The principle of the Doppler shift may be simply illustrated with reference to Fig. III-6, which shows a scatterer moving with velocity v. If the SODAR transmits a frequency f, the scattered signal from the scattering object is received at a frequency shifted from f by an amount f_d given by

$$f_d = \frac{2v_d}{c} f = \frac{2v}{c} f \cos \text{theta}$$

where c is the speed of sound. The quantity v_d is the Doppler velocity in the direction of the SODAR, and theta is between those two directions. Note that the Doppler frequency f_d will carry a sign, i.e., Doppler velocities toward the SODAR give rise to positive Doppler shifts, those away from the SODAR are negative shifts.

7.0 SODAR OPERATING PRINCIPLES

The Doppler SODAR system functions like a pulsed radar, but instead of an electromagnetic wave, it emits an acoustic wave at a frequency of 1600 Hz. The SODAR has three antennae, which for convenience, we number 1, 2, and 3. Antenna 1 is the vertical antenna, and antennae 2 and 3 are tilted from the vertical at an angle of 18 degrees.

This three-dimensional configuration of the SODAR system permits the measurement of three-dimensional wind speed [horizontal wind speed, the direction (theta) of the horizontal wind, and vertical wind speed (w)] as well as the standard deviation of w and the standard deviation of theta. These are highly useful turbulence/stability indicators. For each of the three antennae, the measurement cycle is composed of a brief acoustic burst whose pulse length is on the order of 150 ms.

The series of acoustic waves propagating outward through the atmosphere is partially reflected back to the antenna as a continuous echo train due to slight variations of temperature (and thus of density) along the pulse path. To detect these returning echos, the compression driver is electronically switched into a sensitive microphone configuration immediately after the acoustic burst has been generated.

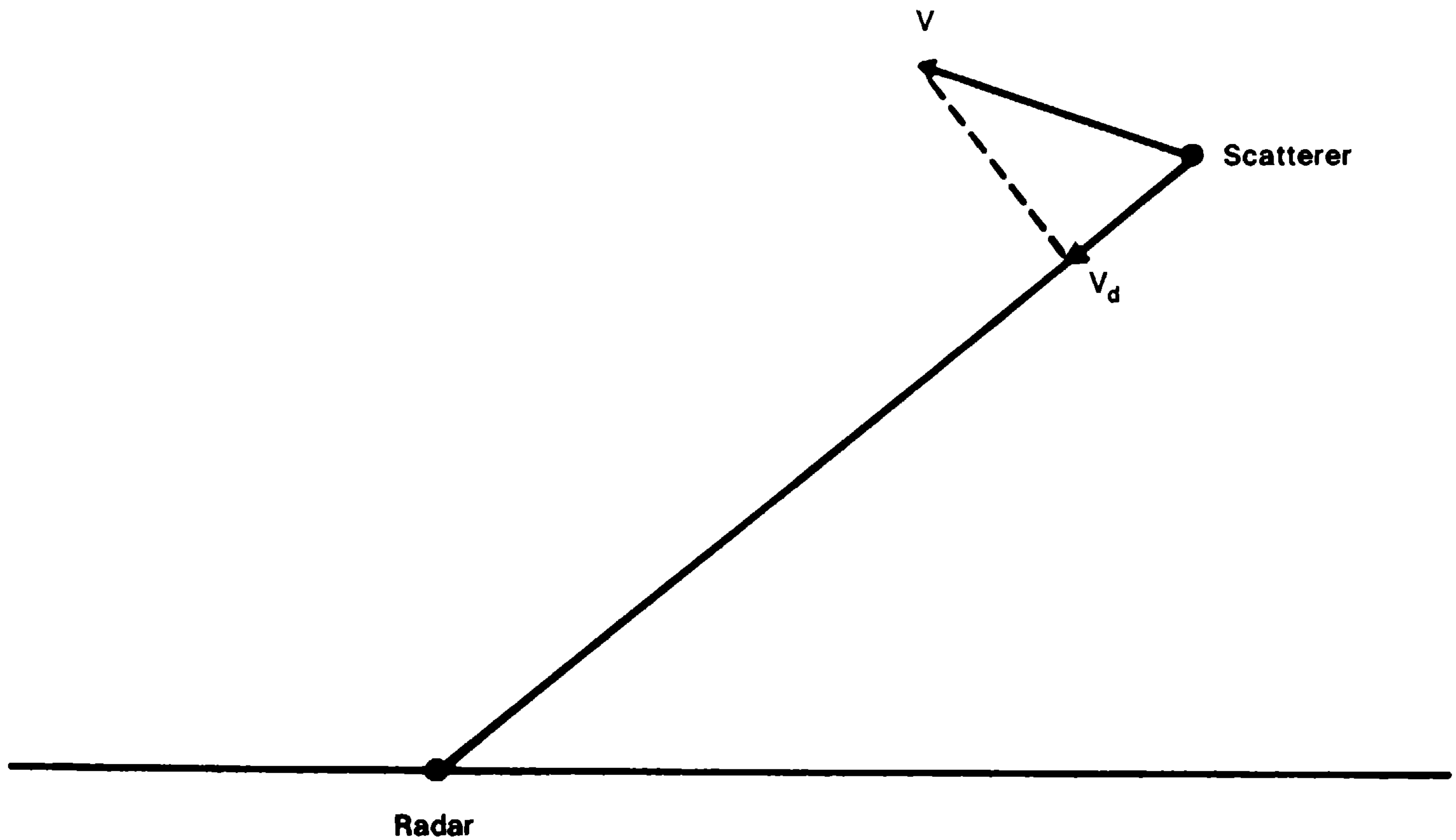


Figure III-6. Doppler volocity (V_d) for a single scatterer moving at a velocity V.

The altitude from which a given portion of the sound energy was scattered is easily calculated by noting that at the end of a period of time "t" following a transmission, the sound has made a round trip of

$$x = t \cdot c, \text{ where c is the speed of sound.}$$

Because it is a round trip, the corresponding altitude is

$$z = \frac{x}{2}$$

We have, therefore, $z = t \cdot \frac{c}{2}$.

In the case of tilted antennae, $z = t \cdot \frac{c}{2} \cdot \cos i$

where i is the angle of tilt from vertical.

To accomplish these measurements layer by layer, it is necessary to divide the time after transmission into corresponding segments of time. Figure III-7 shows a summary of these principles.

The echo received by the antenna after a pulse transmission has certain characteristics, one of which is that the signal is extremely weak. To illustrate this statement, the voltage applied to the terminals of a compression driver during transmission is approximately 60 V. However, during reception it can be as weak as 30 nV (30×10^{-9} V) and never exceeds 10μV (10×10^{-6} V), unless a very high degree of ambient noise is present during the measurement. Therefore, the received echo is not audible to the operator because it is several dB lower than the auditory threshold of the human ear.

With such a weak received signal, the question arises as to the plausibility of obtaining any measurements at all. In fact, by using the techniques outlined below, we find signal reception is perfectly feasible, as

1) The antennae are directional, thus limiting by 50 dB any incoming ambient noise parallel to the ground. In addition, the antennae were specifically designed for very low noise transmission reception.

2) The receiver's thermal and electronic noise is limited to 15 nV by using performance filters and by making scientifically sound choices in reference to the amplification chain and its associated electronic components.

3) Finally, the method employed by the minicomputer in processing the returned pulse allows the use of signals "polluted" by high levels of ambient noise.

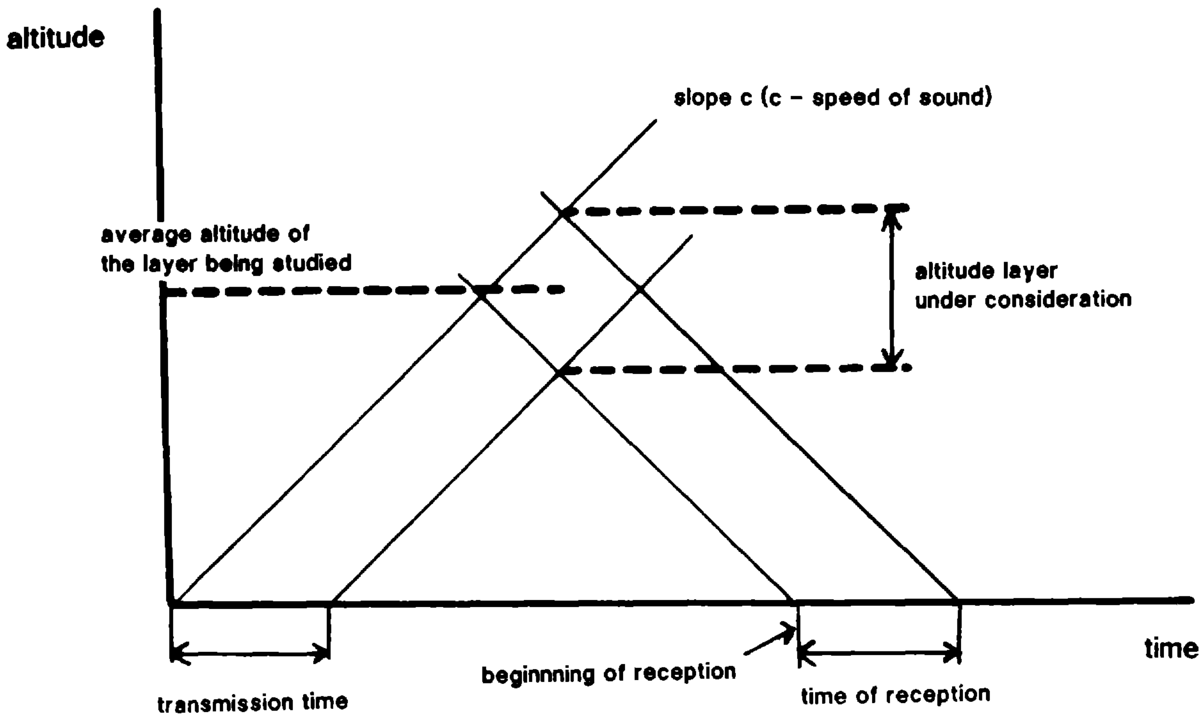


Figure III-7. SODAR method for height determination.

Because of all these factors, the maximum allowable acoustic environmental noise level is 65 dBA for the standard systems. But, because the relevant parameter for measurement is the signal-to-noise ratio, it is possible to measure at higher ambient noise levels under "good" meteorological conditions.

NOTE: Ambient noise does not affect data quality because the software takes care of signal-to-noise ratio and can invalidate individual measurement in case of too-high ambient noise without improperly skewing average wind speed.

The SODAR system is an effective tool for making atmospheric measurements. The first piece of information extracted from the measurement is the intensity of the effective backscattered signals. The SODAR subtracts the ambient noise from the information received by the compression drivers, retaining only the echo return.

The intensity of this received echo depends, as is the case of any radar, on the length and power of the transmitted pulse, the beam of width of the receiving antenna, the atmospheric scattering characteristics, and the attenuation during the round-trip passage. The power of the scattered echo is proportional to the temperature structure C_T^2, defined as

$$C_T^2 = \frac{\overline{(T(x + r) - T(x))^2}}{r^{2/3}}$$

In this equation,

1) The horizontal line above the numerator represents a temporal average
2) $T(x + r)$ and $T(x)$ are the air temperature at the end points of the vectors $x + r$ and x, respectively.
3) r is on the order of the half-length of an acoustic wave (10 cm at 1600 Hz operating frequency).

Expressed more simply, C_T^2 is a measure of the intensity of the small-scale fluctuations of the air temperature. Thus, the SODAR system does not measure average temperature, but rather the quantity C_T^2. This is valuable because C_T^2 has large values and repeatable patterns during conditions such as ground-based radiation inversion, elevated inversion layers, the periphery of convective columns or thermals, sea breeze/land breeze frontal surface, and (in a general way) at the boundary between masses of air at different temperatures.

The SODAR system can thus provide an excellent and continuous record of the atmospheric thermal structure. For example, it readily provides the height of the "mixed layer" so necessary to air-pollution modeling and control efforts.

The second kind of information that the SODAR system calculates, based on the backscattered echo received by each antenna, is the radial wind speed along the beam axis at each altitude layer sampled. The small elements of thermal turbulence responsible for the C_T^2 move at the speed of the wind, thus a double Doppler effect results. When the acoustic beam reaches them, the first Doppler effect is realized while the observer is fixed and the target is in motion. Then, when these cells rebroadcast by backscattering a part of the sound energy they have received, a second Doppler effect is obtained from the point of view of the observer, who is still in a fixed position, but this time the Doppler effect is caused by a mobile transmitter. For example, the frequency variation is on the order of 10 Hz for each meter per second of radial wind speed, at a signal frequency of 1600 Hz. Of course, in practice, this frequency shift can be strongly skewed or even erased by the presence of excessive ambient noise.

Radial speeds for each altitude layer sampled are therefore obtained for every transmission-reception cycle along the beam axis of each antenna. To do this, one divides the timing into discrete steps, starting at the end of each pulse transmission. The minicomputer then cycles the transceiver to begin the same procedure on another antenna, and so on; the simplest cycle obviously being 1,2,3/1,2,3 etc.

Because the SODAR system has three antennae, it can calculate the three-dimensional wind speed components by a simple mathematical coordinate transformation. In addition, the resultant wind speed (V) and direction (theta) of the horizontal winds and vertical winds (w) are also calculated.

Chapter IV
HANDAR INTERROGATED RADIO SYSTEM

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Environmental Sciences Division

1.0 SYSTEM DESCRIPTION

The HANDAR interrogated radio system is used to acquire meteorological data from remote weather stations and to log it onto the CHAWS computer system. This system is composed of two parts, the weather stations and the radio base station.

Each weather station has a tower with at least one level of instrumentation and a HANDAR 540A Data Collection Platform (DCP). Some stations may also have ancillary equipment, such as air quality monitoring sensors. For a description of these products or other sensors, consult the manual for each device and the appropriate Volume of CHAWS Standard Operating Procedures Manual.

2.0 HANDAR 540A DATA COLLECTION PLATFORM (DCP)

One of these units is connected to each station's sensors through a wiring harness. Analog signals are converted to digital information and stored in the 540A's memory where it will reside for up to one week, depending upon the type of program used (see Table 1 for expected holding times). At regular intervals, the radio base station will poll each weather station via a UHF radio link. At that time, the 540A will send data from the most recent 15-min period. Each 540A is given a unique identification number and is programmed with a set of instructions specific for the type and number of sensors at its location.

Table 1. Data Holding Capacity of the 540A

Program type	Amount of data stored (hours)
1	150
2	56
3	36
4	24

2.1 Hardware architecture

The 540A consists of a variety of electronic printed circuit cards in a weatherproof, lockable stainless steel box. A rechargeable gel cell battery is used for power. An external charging circuit is also provided, which could consist of either a solar panel or an AC power supply. If the 540A is mounted on its side with the hinge down, or flat with the hinge towards you, the circuit cards, listed from right to left are as follows:

- Support Card - contains most power conversion functions.

- CPU Card - this card is in a shielded slot.

- Radio Card - this is a double card that occupies 2 slots.

- Met Cards - there are 1 to 3 Met cards installed in each 540A. They are connected to the weather sensors and do the analog to digital conversion. The met cards are numbered from left to right so Met card #1 will be closest to the battery on the left side.

The power switch for the unit is inside the unit, near the hinge, slightly left of center. For more information, consult the "540A-1 Multiple Access Data Acquisition System Operating and Service Manual".

2.2 Programming the 540A

Before the 540A may be used, it must be programmed and given an identity number. This must be done every time it is turned on, loses power, or fails to communicate with the operator.

The operator may communicate with the 540A through the radio base station or through its local programming port and remote terminal, such as a Radio Shack Tandy 102 hand-held computer.

A quick programming reference is presented as Appendix IV-A. It will probably be most useful after working through this manual to learn the system. After that the quick programming reference may be all that is necessary.

2.2.1 Using the radio base station to communicate to the 540A.

The radio base station program is usually run on Slave #2 of the CHAWS computer (See Chapter V). Most of the time, this program is in the Poll/Monitor mode. Press the <F10> key on Slave #2's Kimtron terminal until the main menu appears. Select <F3>, INTERACTIVE COMMUNICATIONS, from the Main Menu. Enter the station ID of the 540A DCP that is desired <Enter>. The station IDs are as follows:

Table 2. Station Type Placement

Type	Station numbers	540A Program name
1	2, 5,	TYPE1P.540
2	3, 4, 7	TYPE2P.540
3	6	TYPE3P.540
4	1	TYPE4.540

2.2.1.1 540A log-on. After entering the station ID, a message at the top of the screen should read "TRANSMITTING", then "RECEIVING" or "AWAITING RESPONSE". When contact has been made, you will receive a log-on message that says

"P HANDAR 540A DCP - REV X.X"

where "X.X" is the firmware version number. The first letter may be an "R" or a "P".

Once the station is logged on, any command in the HANDAR 540A Operating & Service Manual may be given to the 540A.

2.2.1.2 Changing the 540A's ID. If more than one of the 540A DCP's have lost power or have never been programmed, use the following procedures:

- Turn off all but one of the 540A DCPs that require a new ID.
- In response to "Enter the platform ID:", type "0" (zero), <Enter> (for the temporary station ID). When the 540A is logged on, type "I", followed by the correct eight-digit (e.g., 00000001) station ID of the 540A to be programmed <Enter> (see station ID list). Now hit <F5> (log off) until "no

DCP logged on" message appears at top of the screen, then hit <F1> (log on) and type the correct (new) station ID (leading 0's may be omitted this time) followed by <Enter>.

2.2.1.3 Programming a 540A from the Base Station. If a 540A is to be reprogrammed, be sure that it is in the program mode. If not, follow the procedures in 2.2.4 to terminate a 540A program.

540A programs that may be used are "TYPE1P.540", "TYPE2P.540", "TYPE3P.540", or "TYPE4.540" (Appendix IV-B). These programs may be found in the /SLAVE directory of the CHAWS computer. A list of the programs to be used with each station may be found in Table 2.

Hit <F2> (Load Prog) key. When the screen says

"LOAD PS PROG -> DCP:PRESS ENTER",

hit <Enter> and type the name of the 540A program. Press the <Enter> key and this program will be loaded into the 540A. If the program was loaded successfully, the word "DONE" will appear on the screen. If not, try loading the program again.

Next, type the letter "J" to set the time. Note: all 540A letter commands must be capitals and most single letter commands should not be followed by <Enter>. Type in the time as it will be displayed in the upper right-hand corner of the screen one minute into the future and press <Enter> to set the time. Hit the "V" key and check the year. If the year is incorrect, type in the correct date, followed by <Enter>. If the year is correct, go on to the next step (do not hit <Enter>). Now hit "V" again and do the same for the Julian date. Again, do not hit <Enter> unless changing the date.

When programming has been completed for this DCP, put the system in run mode by following the instruction in 2.2.3.

2.2.1.4 540A data acquisition. After the 540A has been programmed, the data-acquisition program must be started. The system must be in run mode.

Enter the following key sequence: H,N,O,V. The last line on the screen should say:

"P1 START OF MEAS. xx:xx:xx".

Where "xx:xx:xx" is a time in 24-hour format. If you overshoot, press "U" to step back up through the menu.

Enter a time, at least two minutes in the future, that falls on an even 15-min time period, but do not include seconds. Hit <Enter>. If the message

"CHANGE ALL CHAN? (1=Y, 2=NO)"

does not appear, go back to the beginning of this sequence. If the message does appear, type "1" <Enter>. Lists of channels are found in Tables 3 and 4. Now type the letter "Y" again to start the program.

Type the letter "S". The message

"R01 NEXT SCAN xx.xx.xx"

will appear. The "xx.xx.xx" is a time in 24-hour format. If the time is less than 15 minutes, type "MVS". Another NEXT SCAN time will appear. If either time is greater than 15 minutes (e.g. 23:14:00), follow the procedure in 2.2.3 (terminate 540A program) and go back to the beginning of this sequence. If the time is less than 15 minutes, then proceed.

If more 540A's are to be programmed, repeat the log-on and 540A programming procedures and resume at step 2.2.1.4.

If the radio base station is being used to perform these procedures, press <F10> to return to the main menu. Be sure to return to the polling menu when finished.

Table 3. 540A DCP Channel Configuration List

Channel	Description
1	Battery Voltage
26	Temp. level 2 (^oC) (4 m)
36	Temp. level 3 (^oC) (8 m)
46	Temp. level 4 (^oC) (16 m)
56	Temp. level 5 (^oC) (32 m)
66	Temp. level 6 (^oC) (64 m)
28	Humidity level 2 (%) (4 m)
38	Humidity level 3 (%) (8 m)
41	Wind speed level 4 (m/s)
51	Wind speed level 5 (m/s)
61	Wind speed level 6 (m/s)
43	Wind direction level 4 (deg.)
53	Wind direction level 5 (deg.)
63	Wind direction level 6 (deg.)
44	Standard dev. of wind direction level 4
54	Standard dev. of wind direction level 5
64	Standard dev. of wind direction level 6

Table 4. Station Type Configuration

Channel	Sensor
	TYPE 1
1	Battery Voltage
61	Wind speed level 6 (m/s)
63	Wind direction level 6 (deg.)
64	Standard dev. of wind direction level 6
66	Temp. level 6 (^oC)
	TYPE 2
1	Battery Voltage
2	Air quality, signal
3	Air quality, NO
7	Air quality, O_3
8	Air quality, SO_2
9	Air quality, NO_x
61	Wind speed level 6 (m/s)
63	Wind direction level 6 (deg.)
64	Standard dev. of wind direction level 6
66	Temp. level 6 (^oC)

Table 4. Station Type Configuration - Contd.

Channel	Sensor TYPE 3
1	Battery Voltage
26	Temp. level 2 (^{o}C)
28	Humidity level 2 (%)
36	Temp. level 3 (^{o}C)
38	Humidity level 3 (%)
41	Wind speed level 4 (m/s)
43	Wind direction level 4 (deg.)
44	Standard dev. of wind direction level 4
46	Temp. level 4 (^{o}C)
51	Wind speed level 5 (m/s)
53	Wind direction level 5 (deg.)
54	Standard dev. of wind direction level 5
56	Temp. level 5 (^{o}C)
61	Wind speed level 6 (m/s)
63	Wind direction level 6 (deg.)
64	Standard dev. of wind direction level 6
66	Temp. level 6 (^{o}C)

TYPE 4 This combines the channels of type 2 and type 3 stations, which are as follows:

1, 2, 3, 7, 8, 9
26, 28
36, 38
41, 43, 44, 46
51, 53, 54, 56
61, 63, 64, 66

2.2.1.5 Saving a 540A program. From the Interactive Menu of the base station program, log onto the 540A that contains the program to be saved. Hit the <F3> key on the base station slave computer. Observe the "TRANSMITTING", "RECEIVING" message at the top of the screen. This will be followed by the message,

"SAVE DCP PROG->PS: PRESS ENTER".

Press <Enter>. Type in the name of the file in which the 540A program is to be saved and press <Enter>. Observe again the "TRANSMITTING", "RECEIVING" messages at the top of the screen again. When finished, a "DONE" prompt will appear.

Now put the 540A back into the run or data-acquisition mode as described in 2.2.1.4.

2.2.2 Using a portable computer to communicate to the 540A.

The Tandy model 100 or Tandy model 102 portable computer has been provided. Consult the owners manual for the proper use of this computer. If the unit is not already in the terminal mode, perform the following steps:

1. Select "TELCOM" from the main menu by moving the cursor to that item with the space bar and press <Enter>.

2. If the message "37E1E,10 pps" is not displayed somewhere on the screen, press <F3> (or type "STAT" <Enter>) and type "37E1E" <Enter>.

3. Press <F4> (TERM).

4. Connect the special cable between the 540A PROG/IO port and the 25-pin "D" connector on the back of the computer.

2.2.2.1 540A log-on. Within 30 seconds after the connection has been made between the 540A and the Tandy computer, this log-on message appears:

"P HANDAR 540A DCP - REV X.X"

where "X.X" is the firmware version number. The first letter may be either an "R" or a "P".

Once the station is logged on, any command in the HANDAR 540A Operating & Service Manual may be given to the 540A.

2.2.2.2 Changing the 540A's ID. The ID number of a 540A may be changed at any time as long as the unit is in the program mode. This is usually done after the unit has been turned on, as the ID will always come up as zero.

Be sure the 540A is in the program mode. If not, type "?" to terminate the program and place it in program mode.

Type the capital letter "I". The 540A will respond with an 8-digit number. If the ID is to be changed, enter the new 8-digit number. For example, if this is station 1, type "00000001" <Enter>.

2.2.2.3 Programming a 540A with the Tandy hand-held computer. To program the 540A, be sure that it is in the program mode (a "P" will be displayed on the left side of the screen). If not, terminate the program by following the procedure in 2.2.3.

Now type "&". The 540A will respond with

"LOAD PS PROG->DCP: PRESS ENTER".

Press the <F3> key on the Tandy and enter the 540A program name. Enter "120" when the Tandy asks for width and press <Enter> twice. When finished, the 540A will respond with "DONE". Now enter a "J" and enter a time 1 minute ahead of local standard time followed by <Enter>. Hit the "V" key and enter two digits for the year. Hit "V" again and enter the Julian date followed by <Enter>.

After completing the programming, put the 540A in the run or data-acquisition mode as directed in 2.2.1.4.

2.2.2.4 Saving a 540A program To save a program from a 540A, put it in the program mode as listed below. Enter a "%". The 540A will respond with

"SAVE PS PROG->DCP: PRESS ENTER".

Press <F2>. Type the name of the program you wish to save, <Enter>. Press <Enter> again. When the program has been saved, the 540A will respond with "DONE". Hit <F2> again. Follow the editing instructions in the Tandy manual to remove the word "DONE" from the bottom of the program file and any extraneous text from the beginning.

2.2.3 540A DCP program termination.

Do not use the following procedure if the 540A is already in the program mode. To do so may "hang up" the 540A to the point it must be shut off and reprogrammed. If messages from the DCP are preceded by the letter "P", then it is already in the program mode.

If this procedure is being conducted from the radio base station, make sure the program is in interactive mode. From the polling screen, hit <F10> <F3>. Log onto the platform desired by responding to the prompt "Enter the platform ID:" followed by <Enter>.

If a 540A program is stopped, all data stored in it will be lost. To stop the program, type "?". The 540A will respond with

"R ENTER(1)=SERVICE (2)=ALL".

Press "2" <Enter>. The 540A is now in the program mode and will not collect any data until placed in the run mode.

3.0 RADIO BASE STATION

The base station hardware consists of an omni-directional antenna, HANDAR 542 radio transceiver and an IBM PC/XT compatible computer (Slave #2). The software used is a modified version of the HANDAR BASE.EXE.

3.1 Software start-up

Normally, the base station software will start in the Poll/Monitor mode when the computer system is turned on. If the program has been terminated, it may be restarted by rebooting Slave #2 or typing "BASE -A900" <Enter>. It will begin to poll at the next quarter hour. If desired, you may type "BASE -A1" <Enter> to have it begin to poll within 10 seconds. This should not be done as a general rule and after one poll in this mode, Slave #2 should be rebooted.

3.2 Termination of BASE.EXE execution

Do not terminate the BASE.EXE program unless there is a specific need to do so. Routine data from the weather stations will be lost if the program is not running at the quarter hour.

From most menus, hit <F10> until the message

"Terminate base station program? (Yes/No):"

appears. Enter "Y". From other menus you may have to respond to a specific prompt before you can hit <F10>.

Remember to restart the program as soon as possible after completing the special procedures that required BASE.EXE to be stopped.

3.3 Interactive communications

As mentioned above, this mode can be used to initialize and program a 540A DCP. See Appendix IV-A. In addition, certain other procedures may be performed.

If the base station program is in the Poll/Monitor mode, select <F10> to return to the main menu. Select <F3>, INTERACTIVE COMMUNICATIONS, from the Main Menu. Enter the station ID of the new station and hit <Enter>.

3.3.1 Polling data on demand.

From the interactive-mode screen, after the platform is logged on, hit <F4> and the polling menu should appear. Answer the questions in this menu regarding start time, stop time, date, logging, and printing. Now hit <F9> to poll and wait until polling is completed. If you wish to poll another station, press <F5> (log off), then <F1> (log on), and enter the new station number. Repeat this section to poll the new station.

3.3.2 Time check.

Wait until a routine poll has ended. Reboot the host PC/AT computer. After the base station program has started again on Slave #2, enter the interactive mode as described in 3.3 (<F10> <F3>) and log on to the 540A in question.

The DCP's time must be about one minute ahead of the radio base station's clock to allow for any time slippage. Make sure that you are in the program mode. Hit the "J" key and look at the clock in the upper right-hand corner of the computer screen. If the time reported by the 540A is behind that of the computer, the time must be changed.

To change the 540A time, the program must be stopped. This will result in the loss of at least 15 minutes of data. Terminate the 540A program by following the procedures in section 2.2.3. Now hit "J". When the time appears, type in a time about one minute in the future of the clock in the upper right-hand corner of the screen. Now restart the program as stated in 2.2.1.4.

3.4 <u>External mode</u>

This mode allows the user to perform simple DOS commands between polls. From the Main Menu, select <F4> (EXTERNAL SOFTWARE EXECUTION). This suspends all radio base station functions except for the polling timer. Do not run other software programs in this mode as it may interfere with subsequent polling. Simple DOS commands such as DIR, COPY, DEL etc. may now be executed as long as they do not take more than about 25 seconds. To return to the polling mode, terminate the execution of external functions and type the word "EXIT" <Enter>. The main menu should appear. Now return to the Poll/Monitor mode, described below.

3.5 <u>The Poll/Monitor mode</u>

If the MAIN MENU is not on the screen, hit <F10> until it appears. Now select <F2> (Poll/Monitor). Any data that should have been logged prior to this point will now be taken. The radio base station software should be left in this mode whenever possible so that the host computer will always have the most current data.

4.0 TROUBLESHOOTING GUIDE

The following is a list of potential problems and probable solutions.

4.1 <u>None of the 540As will respond to the radio base station</u>

4.1.1 Check the 542 transceiver set up.

Ensure that the HANDAR 542 transceiver is turned on and connected to both the computer and antenna. Also make certain that the base station antenna is still in its proper orientation. If these conditions are correct and none of the 540A's respond, try the following.

4.1.1.1 Test the 542 base station. Replace the radio base station transceiver with a spare 542. If the system works, have the old transceiver repaired.

4.1.1.2 Check the computer's communication configuration. Ensure that the communication port specified in the base station configuration table is the same as the one that the transceiver is connected to. If not, make the necessary changes. The correct port is usually COM2.

4.1.1.3 Test the base station's slave card. Connect the transceiver to a different slave card or to the host computer. Run the radio base station software on that computer and try to communicate with the 540As again. Please note that if the host's COM1 serial port is used for this test, it will be necessary to change the communications parameters in the base station software configuration table to COM1. At the conclusion of the test make sure to change them back to COM2. If communications are established with the 540As, replace the slave card and have the old one repaired.

4.1.1.4 Test all base station cables. Replace the cables between the computer and the 542 transceiver. If this works, discard the old cable.

4.1.1.5 Check the base station antenna. If none of the stations will respond to the radio base station after the above solutions are tried, replace the antenna and/or antenna cable at the base station.

4.2 <u>Check all of the 540A DCPs</u>

In the unlikely event that ALL of the 540As have some problem, the base station communication problems may be cured by fixing each of the 540As. Go to each station and follow the diagnostic procedures for individual 540As listed below.

4.2.1 Individual 540As will not respond.

If individual 540A DCP's will not communicate with the base station, take the portable computer to the 540A in question and establish contact as described in section 2.2.2.

4.2.2 540A will not respond to portable computer.

If the 540A will not log on to the portable computer, turn the 540A off, wait 10 seconds and turn it on. If it still won't log on, try the following procedures:

4.2.2.1 Check the 540As battery voltage and power system. Is the battery voltage above 12 volts? This may be checked with a voltmeter and/or by typing a "W" on the portable computer after the 540A has logged on. If not, try the following:

- Check the voltage on the charging circuit. If the charging circuit is bad, make necessary repairs.
- Turn off the 540A and replace the support card. If the battery is then able to charge when the 540A is turned back on, have the support card repaired. Be sure to reprogram the 540A and start its program.
- Turn off the 540A and remove the battery leads from the battery and connect an external battery charger. If the battery does not charge in a reasonable period of time (overnight), replace it.

4.2.2.2 Check the 540A's printed circuit card. If the power system is OK, turn off the 540A, replace the support card, and turn it back on. If it logs on to the portable computer, have the old support card repaired.

If the support card was not the problem, repeat this procedure with the CPU card, MET cards, and radio card.

If the 540A DCP logs on to the portable computer after any one of these substitutions, have that card repaired. Be sure to I.D. and reprogram the DCP.

4.2.3 Check the 540A's identity number.

Is the ID correct for that station? If not, correct the ID as described above in section 2.2.2.2.

4.2.4 Check the 540A's radio card.

If the 540A still does not communicate with the base station, turn off the 540A and replace the radio card. Turn it back on. If it communicates with the base station, have the old radio card repaired.

4.2.5 Check 540A's antenna system.

Inspect the antenna and antenna cable at each station. Use a field strength meter to determine if radio transmissions are occurring during a normal polling time. Correct any discrepancies. Be sure that the antenna's alignment is still correct.

4.2.6 Conclude 540A tests.

Once communications with the 540A are established and the unit is working properly, reprogram it and re-enter the correct base station ID, as described in sections 2.2.2.2 and 2.2.2.3. Once the 540A DCP has been given its proper I.D., it may be reprogrammed from the radio base station by using the procedures outlined in Appendix A.

5.0 LIST OF MANUALS NEEDED FOR CHAPTER IV

1. Operating and Service Manual for Interrogated Radio Systems. HANDAR, Inc., Sunnyvale, CA 94089

2. 540A-1 Multiple Access Data Acquisition System Operating & Service Manual. HANDAR, Inc., Sunnyvale, CA 94089.

3. Model KT-7/PC Terminal Operator's Manual. Kimtron Corporation.

4. Tandy Model 102 Operator's Manual.

Appendix IV-A

540A Quick Programming Reference

The radio base station program is usually run on Slave #2 of the CHAWS computer. Most of the time, this program is in the Poll/Monitor mode (Fig. IV-1). Press the <F10> key on the Slave #2's Kimtron terminal until the main menu (Fig. IV-2) appears. Select <F3>, INTERACTIVE COMMUNICATIONS, from the Main Menu. This will call the menu displayed in Figure IV-3.

```
Poll/Monitor mode         Polling enabled                              099 13:39:06
-------------------------------------------------------------------------------------
              --- Next poll time:  099 13:45:00  DCP 00000001 ---

13:39  C:/SLAVE>ECHO OFF















-------------------------------------------------------------------------------------
1 Enable polling  2 Display status  3 Reset poll  4 Disable polling  10 Return
```

Figure IV-1. Poll/Monitor menu.

Startup mode 099 13:40:14

HANDAR REMOTE DATA COLLECTION SYSTEM CONTROLLER

VHF RADIO VERSION

VERSION R1.1 (c) HANDAR 1984

MAIN MENU

1. CONFIGURATION

2. POLL/MONITOR

3. INTERACTIVE COMMUNICATION

4. EXTERNAL PROGRAM EXECUTION

10. EXIT TO OPERATING SYSTEM

ENTER SELECTION:

Figure IV-2. Main menu.

Interactive mode   No DCP logged on   099 13:40:17

Enter the platform ID:

Figure IV-3. Interactive menu.

540A LOG-ON.

While in the interactive mode (Fig. IV-3), enter the station ID of the 540A DCP that is desired and press <Enter>. A message at the top of the screen will read

"TRANSMITTING...", then
"AWAITING RESPONSE...", then
"RECEIVING..."

When contact has been made, you will receive a log-on message that says:

"P HANDAR 540A DCP - REV X.X"

where "X.X" is the firmware version number (see Fig. IV-4). The first letter may be an "R" or a "P".

Once the station is logged on, any command in the HANDAR 540A Operating & Service Manual may be given to the 540A.

Procedure	Key Strokes	Screen Display
		Interactive mode Logged on to DCP 00000006 099 15:42:35
END RUN		R HANDAR 540A DCP - REV 6.7
	I	R ID 00000006
	?	R ENTER(1)=SERVICE (2)=ALL 2
	2 <Enter>	P HANDAR 540A DCP - REV 6.7
	<F2> <Enter>	LOAD PS PROG->DCP: PRESS ENTER
PROGRAM	TYPE1.540 <Enter>	P DONE
	J	P STATION TIME 15:41:06 15:43:35
SET TIME	15:43:35 <Enter>	P STATION TIME 15:43:35
	V	P YEAR (XX) 87
	V	P DCP JULIAN DATE 099
START TIME	HNOV	P HANDAR 540A DCP - REV 6.7
		P01 SENSOR TYPE 12
		P01 MEAS INTERVAL 00:15:00
	15:45	P01 START OF MEAS 15:45:00 15:45:
	1 <Enter>	CHANGE ALL CHANS ? (1=Y,2=N) 1
		P01 START OF MEAS 15:45:00
START RUN	Y	R RUN/MONITOR MODE
CHECK TIME	S	R01 NEXT SCAN 00:02:12
	M	R CHANNEL NO. 01
	V	R CHANNEL NO. 31
	S	R31 NEXT SCAN 00:01:45
POLL/MON.	<F10> <F2>	1 Log on 2 Load prog 3 Save prog 4 Poll data 5 Log off 10 Return

Figure IV-4. Interactive menu, sample session using TYPE1.540.

PROGRAMMING A 540A.

If the 540A is to be reprogrammed, be sure that it is in the program mode. It is in this mode if each line begins with the letter "P". If not, perform the procedures in the 540A DCP PROGRAM TERMINATION section below. Figure IV-4 may be used as a reference for these procedures. Key Stroke lines 1 through 3 in this figure must be omitted if the 540A is in the program mode.

Hit <F2> (Load Prog) key. When the screen says

"LOAD PS PROG -> DCP:PRESS ENTER",

press the <Enter> key. The bottom of the screen should now save

"Enter DCP program filename:"

Obtain the name of the 540A program to be used with this 540A from Table 2. Now type the name of the 540A program to be used (e.g., TYPE1.540). Press the <Enter> key and this program will be loaded into the 540A. If the program was loaded successfully, the word

"DONE"

will appear on the screen. If not, try loading the program again.

Next, type the letter "J" to set the time. All 540A letter commands must be capitals and most single letter commands should not be followed by <Enter>.

Type in the time as it will be displayed in the upper right hand corner of the screen one minute into the future and press <Enter> to set the time. Hit the "V" key and check the year. Type in the correct date, followed by <Enter>. Now hit "V" again and do the same for the Julian date.

540A DATA ACQUISITION.

After the 540A has been programmed, the data-acquisition program must be started.

Enter the following key sequence: H,N,O,V. The last message line on the screen should say:

"P1 START OF MEAS. xx:xx:xx".

where "xx:xx:xx" is a time in 24-hour format. If you overshoot, press "U" to step back up through the menu. Enter a time, at least two minutes in the future, that falls on the quarter hour but do not include seconds. Hit <Enter>. This time must be entered even if the reported time is correct. If the message

"CHANGE ALL CHAN? (1=Y, 2=NO)"

does not appear, go back to the beginning of this section, 540A DATA ACQUISITION, and start over. If this message is received, Type "1" <Enter>. Now type the letter "Y" again to start the program. Type the letter "S". The message

"R01 NEXT SCAN xx.xx.xx"

will appear. The "xx.xx.xx" is a time in 24-hour format. If the time is less than 15 minutes, type "MVS". Another NEXT SCAN time will appear. If either time is greater than 15 minutes (e.g. 23:14:00), follow the procedure in the TERMINATE 540A PROGRAM section below and go back to the beginning of this section and start over. If the time is less than 15 minutes, then proceed. The programming of this 540A is complete.

If more 540A's are to be programmed, hit the <F5> key, LOG OFF, then hit the <F1> key, LOG ON. Now repeat the log-on and 540A programming procedures above.

If this is the last 540A, hit the <F10> key, then hit the <F2> key from the MAIN MENU and data logging should resume on the Handar Slave Computer.

CHANGING THE 540A'S ID.

If more than one of the DCP's have lost power or have never been programmed, use the following procedures. Turn off all but one of the 540A Data Collection Platforms that require a new ID.

Type "0" (zero) <Enter> (for the temporary station ID) in response to "Enter the platform ID:". When the 540A is logged on, type "I" , followed by the correct, eight-digit (e.g., 00000001) station ID of the 540A to be programmed (see station ID list). Now hit <F5> (log off), <F1> (log on) and type the correct (new) station ID (leading 0's may be omitted this time), followed by <Enter>.

540A DCP PROGRAM TERMINATION.

Do not use the following procedure if the 540A is already in the program mode. To do so may "hang up" the 540A to the point it must be shut off and reprogrammed. If messages from the DCP are preceded by the letter "P", then it is already in the program mode.

If a 540A program is stopped, all data stored in it will be lost. To stop the program, type "?". The 540A will respond with:

"R ENTER(1)=SERVICE (2)=ALL".

Press "2" <Enter>. The 540A is now in the program mode and will not collect any data until placed in the run mode.

Appendix IV-B

540A DCP Program Lists

```
P    ID                      00000001          *******************
P    STATION TIME            08:39:20          *                 *
P    YEAR  (XX)                    87          *   Type 1P 540A  *
P    DCP JULIAN DATE              014          *     Program     *
P    GMT  TIME  NOT IMPLEMENTED                *     01-14-87    *
P    DIFT TIME NOT IMPLEMENTED YET             *                 *
P    TIMED REPORT TYPE             00          *******************
P    SEC REPORT TYPE               00
P    COMMUNICATION TYPE            00
P    MAX MESSAGE LENGTH           512
P    TEL #:AREA CODE            0-000
P    TEL #:LOCAL             000-0000
P    DIAL OUT FORMAT               00
P    DIAL IN FORMAT                00
P    PROG TIME (1=Y,0=N)           00
P    1ST DIAL TIME           00:00:00
P    DIAL INTERVAL           00:00:00
P    TEL EMG XMIT 1=ON             00
P    AUTO DUMP? 1=Y 0=N            00
P    1ST LOG TIME            00:00:00
P    LOG INTERVAL            00:00:00
P    DRIVE MODE                    00
P    LOG MODE                      00
P    VOICE OUTPUT MODE             00
P    TOUCH TONE PASSWD              0
P    CHANNEL NO.                   01
P01 SENSOR TYPE                    12       BATTERY VOLTAGE
P01 SENSOR NAME TAG                12
P01 MEAS INTERVAL            00:15:00
P01 START OF MEAS            13:00:00
P01 LEVEL 1 MEAS TYPE             002       AVERAGE
P01 LEVEL 1 SAMP INTVL       00:01:00
P01 LVL1 DATA SET SIZE          00015
P01 LEVEL 2 MEAS TYPE             001       LOG DATA
P01 XMIT 2 OR 3 BYTES?             03
P01 HIGH LIMIT               NO LIMIT
P01 LOW LIMIT                NO LIMIT
P01 HIGH DIFF LIMIT          NO LIMIT
P01 LOW DIFF LIMIT           NO LIMIT
P   CHANNEL NO.                    61
P61 SENSOR TYPE                    01       WIND SPEED
P61 SENSOR NAME TAG                01
P61 CARD SLOT #                    02
P61 SENSOR PWR ADV           00:00:02
P61 *SENS THRESHOLD             000.0
P61 FREQ/VEL (XX.XXX)          00.586
P61 MEAS INTERVAL            00:05:00
P61 START OF MEAS            13:00:00
P61 LEVEL 1 MEAS TYPE             002       AVERAGE
P61 LEVEL 1 SAMP INTVL       00:00:03
P61 LVL1 DATA SET SIZE          00100
```

```
P61 LEVEL 2 MEAS TYPE        001         LOG
P61 XMIT 2 OR 3 BYTES?        03
P61 HIGH LIMIT          NO LIMIT
P61 LOW LIMIT           NO LIMIT
P61 HIGH DIFF LIMIT     NO LIMIT
P61 LOW DIFF LIMIT      NO LIMIT
P   CHANNEL NO.               63
P63 SENSOR TYPE               02         WIND DIRECTION
P63 SENSOR NAME TAG           02
P63 CARD SLOT #               02
P63 SENSOR PWR ADV      00:00:02
P63 WD: 0=POLAR 1=RECT        00
P63 *FULL SCALE              359
P63 ZERO SCALE               000
P63 MEAS INTERVAL       00:05:00
P63 START OF MEAS       13:00:00
P63 LEVEL 1 MEAS TYPE        002         AVERAGE
P63 LEVEL 1 SAMP INTVL  00:00:01
P63 LVL1 DATA SET SIZE     00300
P63 LEVEL 2 MEAS TYPE        001         LOG
P63 SECONDARY CHANNEL         00
P63 XMIT 2 OR 3 BYTES?        03
P   CHANNEL NO.               64
P64 SENSOR TYPE               02         WIND DIRECTION
P64 SENSOR NAME TAG           02
P64 CARD SLOT #               02
P64 SENSOR PWR ADV      00:00:02
P64 WD: 0=POLAR 1=RECT        00
P64 *FULL SCALE            359.9
P64 ZERO SCALE             000.0
P64 MEAS INTERVAL       00:05:00
P64 START OF MEAS       13:00:00
P64 LEVEL 1 MEAS TYPE        003         STANDARD DEVIATION
P64 LEVEL 1 SAMP INTVL  00:00:01
P64 LVL1 DATA SET SIZE     00300
P64 LEVEL 2 MEAS TYPE        001         LOG
P64 SECONDARY CHANNEL         00
P64 XMIT 2 OR 3 BYTES?        03
P   CHANNEL NO.               66
P66 SENSOR TYPE               03         TEMPERATURE
P66 SENSOR NAME TAG           03
P66 CARD SLOT #               02
P66 SENSOR PWR ADV      00:00:02
P66 TEMP INPUT (1-8)          01
P66 TEMP SCALE 0=C 1=F        00
P66 *TEMP FORMAT           000.0
P66 MEAS INTERVAL       00:15:00
P66 START OF MEAS       13:00:00
P66 LEVEL 1 MEAS TYPE        002         AVERAGE
P66 LEVEL 1 SAMP INTVL  00:00:20
P66 LVL1 DATA SET SIZE     00045
P66 LEVEL 2 MEAS TYPE        001         LOG
P66 XMIT 2 OR 3 BYTES?        03
P66 HIGH LIMIT          NO LIMIT
P66 LOW LIMIT           NO LIMIT
P66 HIGH DIFF LIMIT     NO LIMIT
P66 LOW DIFF LIMIT      NO LIMIT
```

```
*******************
*                 *
*   Type 2P 540A  *
*     Program     *
*     01-14-87    *
*                 *
*******************
```

```
P   ID                    00000001
P   STATION TIME          08:36:52
P   YEAR  (XX)                  87
P   DCP JULIAN DATE            014
P   GMT  TIME  NOT IMPLEMENTED
P   DIFT TIME NOT IMPLEMENTED YET
P   TIMED REPORT TYPE           00
P   SEC REPORT TYPE             00
P   COMMUNICATION TYPE          00
P   MAX MESSAGE LENGTH         512
P   TEL #:AREA CODE          0-000
P   TEL #:LOCAL           000-0000
P   DIAL OUT FORMAT             00
P   DIAL IN FORMAT              00
P   PROG TIME (1=Y,0=N)         00
P   1ST DIAL TIME         00:00:00
P   DIAL INTERVAL         00:00:00
P   TEL EMG XMIT 1=ON           00
P   AUTO DUMP? 1=Y 0=N          00
P   1ST LOG TIME          00:00:00
P   LOG INTERVAL          00:00:00
P   DRIVE MODE                  00
P   LOG MODE                    00
P   VOICE OUTPUT MODE           00
P   TOUCH TONE PASSWD            0
P   CHANNEL NO.                 01
P01 SENSOR TYPE                 12       BATTERY VOLTAGE
P01 SENSOR NAME TAG             12
P01 MEAS INTERVAL         00:15:00
P01 START OF MEAS         13:00:00
P01 LEVEL 1 MEAS TYPE          002       AVERAGE
P01 LEVEL 1 SAMP INTVL    00:01:00
P01 LVL1 DATA SET SIZE       00015
P01 LEVEL 2 MEAS TYPE          001       LOG DATA
P01 XMIT 2 OR 3 BYTES?          03
P01 HIGH LIMIT            NO LIMIT
P01 LOW LIMIT             NO LIMIT
P01 HIGH DIFF LIMIT       NO LIMIT
P01 LOW DIFF LIMIT        NO LIMIT
P   CHANNEL NO.                 02
P02 SENSOR TYPE                 10       CAL. SIGNAL
P02 SENSOR NAME TAG             10
P02 CARD SLOT #                 02
P02 SENSOR INPUT ADRS            A
P02 SENSOR PWR ADRS              8
P02 SENSOR PWR ADV        00:00:02
P02 *FULL SCALE              5.000
P02 ZERO SCALE               0.000
P02 MEAS INTERVAL         00:15:00
P02 START OF MEAS         13:00:00
P02 LEVEL 1 MEAS TYPE          002       AVERAGE
P02 LEVEL 1 SAMP INTVL    00:00:10
P02 LVL1 DATA SET SIZE       00090
```

P02	LEVEL 2 MEAS TYPE	001	LOG
P02	XMIT 2 OR 3 BYTES?	03	
P02	HIGH LIMIT	NO LIMIT	
P02	LOW LIMIT	NO LIMIT	
P02	HIGH DIFF LIMIT	NO LIMIT	
P02	LOW DIFF LIMIT	NO LIMIT	
P	CHANNEL NO.	03	
P03	SENSOR TYPE	10	NO (AIR QUALITY)
P03	SENSOR NAME TAG	10	
P03	CARD SLOT #	02	
P03	SENSOR INPUT ADRS	9	
P03	SENSOR PWR ADRS	8	
P03	SENSOR PWR ADV	00:00:02	
P03	*FULL SCALE	5.000	
P03	ZERO SCALE	0.000	
P03	MEAS INTERVAL	00:05:00	
P03	START OF MEAS	13:00:00	
P03	LEVEL 1 MEAS TYPE	002	AVERAGE
P03	LEVEL 1 SAMP INTVL	00:00:10	
P03	LVL1 DATA SET SIZE	00030	
P03	LEVEL 2 MEAS TYPE	001	LOG
P03	XMIT 2 OR 3 BYTES?	03	
P03	HIGH LIMIT	NO LIMIT	
P03	LOW LIMIT	NO LIMIT	
P03	HIGH DIFF LIMIT	NO LIMIT	
P03	LOW DIFF LIMIT	NO LIMIT	
P	CHANNEL NO.	07	
P07	SENSOR TYPE	10	O_3 (AIR QUALITY)
P07	SENSOR NAME TAG	10	
P07	CARD SLOT #	02	
P07	SENSOR INPUT ADRS	8	
P07	SENSOR PWR ADRS	8	
P07	SENSOR PWR ADV	00:00:02	
P07	*FULL SCALE	5.000	
P07	ZERO SCALE	0.000	
P07	MEAS INTERVAL	00:05:00	
P07	START OF MEAS	13:00:00	
P07	LEVEL 1 MEAS TYPE	002	AVERAGE
P07	LEVEL 1 SAMP INTVL	00:00:10	
P07	LVL1 DATA SET SIZE	00030	
P07	LEVEL 2 MEAS TYPE	001	LOG
P07	XMIT 2 OR 3 BYTES?	03	
P07	HIGH LIMIT	NO LIMIT	
P07	LOW LIMIT	NO LIMIT	
P07	HIGH DIFF LIMIT	NO LIMIT	
P07	LOW DIFF LIMIT	NO LIMIT	
P	CHANNEL NO.	08	

P08 SENSOR TYPE	10	SO_2 (AIR QUALITY)
P08 SENSOR NAME TAG	10	
P08 CARD SLOT #	02	
P08 SENSOR INPUT ADRS	4	
P08 SENSOR PWR ADRS	8	
P08 SENSOR PWR ADV	00:00:02	
P08 *FULL SCALE	5.000	
P08 ZERO SCALE	0.000	
P08 MEAS INTERVAL	00:05:00	
P08 START OF MEAS	13:00:00	
P08 LEVEL 1 MEAS TYPE	002	AVERAGE
P08 LEVEL 1 SAMP INTVL	00:00:10	
P08 LVL1 DATA SET SIZE	00030	
P08 LEVEL 2 MEAS TYPE	001	LOG
P08 XMIT 2 OR 3 BYTES?	03	
P08 HIGH LIMIT	NO LIMIT	
P08 LOW LIMIT	NO LIMIT	
P08 HIGH DIFF LIMIT	NO LIMIT	
P08 LOW DIFF LIMIT	NO LIMIT	
P CHANNEL NO.	09	
P09 SENSOR TYPE	10	NO_X (AIR QUALITY)
P09 SENSOR NAME TAG	10	
P09 CARD SLOT #	02	
P09 SENSOR INPUT ADRS	5	
P09 SENSOR PWR ADRS	8	
P09 SENSOR PWR ADV	00:00:02	
P09 *FULL SCALE	5.000	
P09 ZERO SCALE	0.000	
P09 MEAS INTERVAL	00:05:00	
P09 START OF MEAS	13:00:00	
P09 LEVEL 1 MEAS TYPE	002	AVERAGE
P09 LEVEL 1 SAMP INTVL	00:00:10	
P09 LVL1 DATA SET SIZE	00030	
P09 LEVEL 2 MEAS TYPE	001	LOG
P09 XMIT 2 OR 3 BYTES?	03	
P09 HIGH LIMIT	NO LIMIT	
P09 LOW LIMIT	NO LIMIT	
P09 HIGH DIFF LIMIT	NO LIMIT	
P09 LOW DIFF LIMIT	NO LIMIT	
P CHANNEL NO.	61	
P61 SENSOR TYPE	01	WIND SPEED
P61 SENSOR NAME TAG	01	
P61 CARD SLOT #	02	
P61 SENSOR PWR ADV	00:00:02	
P61 *SENS THRESHOLD	000.0	
P61 FREQ/VEL (XX.XXX)	00.586	
P61 MEAS INTERVAL	00:05:00	
P61 START OF MEAS	13:00:00	
P61 LEVEL 1 MEAS TYPE	002	AVERAGE
P61 LEVEL 1 SAMP INTVL	00:00:03	
P61 LVL1 DATA SET SIZE	00100	
P61 LEVEL 2 MEAS TYPE	001	LOG
P61 XMIT 2 OR 3 BYTES?	03	
P61 HIGH LIMIT	NO LIMIT	
P61 LOW LIMIT	NO LIMIT	
P61 HIGH DIFF LIMIT	NO LIMIT	
P61 LOW DIFF LIMIT	NO LIMIT	
P CHANNEL NO.	63	

P63	SENSOR TYPE	02	WIND DIRECTION
P63	SENSOR NAME TAG	02	
P63	CARD SLOT #	02	
P63	SENSOR PWR ADV	00:00:02	
P63	WD: 0=POLAR 1=RECT	00	
P63	*FULL SCALE	359	
P63	ZERO SCALE	000	
P63	MEAS INTERVAL	00:05:00	
P63	START OF MEAS	13:00:00	
P63	LEVEL 1 MEAS TYPE	002	AVERAGE
P63	LEVEL 1 SAMP INTVL	00:00:01	
P63	LVL1 DATA SET SIZE	00300	
P63	LEVEL 2 MEAS TYPE	001	LOG
P63	SECONDARY CHANNEL	00	
P63	XMIT 2 OR 3 BYTES?	03	
P	CHANNEL NO.	64	
P64	SENSOR TYPE	02	WIND DIRECTION
P64	SENSOR NAME TAG	02	
P64	CARD SLOT #	02	
P64	SENSOR PWR ADV	00:00:02	
P64	WD: 0=POLAR 1=RECT	00	
P64	*FULL SCALE	359.9	
P64	ZERO SCALE	000.0	
P64	MEAS INTERVAL	00:05:00	
P64	START OF MEAS	13:00:00	
P64	LEVEL 1 MEAS TYPE	003	STANDARD DEVIATION
P64	LEVEL 1 SAMP INTVL	00:00:01	
P64	LVL1 DATA SET SIZE	00300	
P64	LEVEL 2 MEAS TYPE	001	LOG
P64	SECONDARY CHANNEL	00	
P64	XMIT 2 OR 3 BYTES?	03	
P	CHANNEL NO.	66	TEMPERATURE
P66	SENSOR TYPE	03	
P66	SENSOR NAME TAG	03	
P66	CARD SLOT #	02	
P66	SENSOR PWR ADV	00:00:02	
P66	TEMP INPUT (1-8)	01	
P66	TEMP SCALE 0=C 1=F	00	
P66	*TEMP FORMAT	000.0	
P66	MEAS INTERVAL	00:15:00	
P66	START OF MEAS	13:00:00	AVERAGE
P66	LEVEL 1 MEAS TYPE	002	
P66	LEVEL 1 SAMP INTVL	00:00:20	
P66	LVL1 DATA SET SIZE	00045	LOG
P66	LEVEL 2 MEAS TYPE	001	
P66	XMIT 2 OR 3 BYTES?	03	
P66	HIGH LIMIT	NO LIMIT	
P66	LOW LIMIT	NO LIMIT	
P66	HIGH DIFF LIMIT	NO LIMIT	
P66	LOW DIFF LIMIT	NO LIMIT	

```
*******************
*                 *
*   Type 3P 540A  *
*     Program     *
*     01-14-87    *
*                 *
*******************
```

```
P    ID                      00000006
P    ID                      00000006
P    STATION TIME            13:02:26
P    YEAR  (XX)                    87
P    DCP JULIAN DATE              014
P    GMT  TIME  NOT IMPLEMENTED ET
P    DIFT TIME NOT IMPLEMENTED Y
P    TIMED REPORT TYPE             00
P    SEC REPORT TYPE               00
P    COMMUNICATION TYPE            00
P    MAX MESSAGE LENGTH           512
P    TEL #:AREA CODE            0-000
P    TEL #:LOCAL             000-0000
P    DIAL OUT FORMAT               00
P    DIAL IN FORMAT                00
P    PROG TIME (1=Y,0=N)           00
P    1ST DIAL TIME           00:00:00
P    DIAL INTERVAL           00:00:00
P    TEL EMG XMIT 1=ON             00
P    AUTO DUMP? 1=Y 0=N            00
P    1ST LOG TIME            00:00:00
P    LOG INTERVAL            00:00:00
P    DRIVE MODE                    00
P    LOG MODE                      00
P    VOICE OUTPUT MODE             00
P    TOUCH TONE PASSWD              0
P    CHANNEL NO.                   01        BATTERY VOLTAGE
P01  SENSOR TYPE                   12
P01  SENSOR NAME TAG               12
P01  MEAS INTERVAL           00:15:00
P01  START OF MEAS           13:15:00        AVERAGE
P01  LEVEL 1 MEAS TYPE            002
P01  LEVEL 1 SAMP INTVL      00:01:00
P01  LVL1 DATA SET SIZE         00015        LOG DATA
P01  LEVEL 2 MEAS TYPE            001
P01  XMIT 2 OR 3 BYTES?            03
P01  HIGH LIMIT              NO LIMIT
P01  LOW LIMIT               NO LIMIT
P01  HIGH DIFF LIMIT         NO LIMIT
P01  LOW DIFF LIMIT          NO LIMIT        TEMPERATURE
P    CHANNEL NO.                   26
P26  SENSOR TYPE                   03
P26  SENSOR NAME TAG               03
P26  CARD SLOT #                   02
P26  SENSOR PWR ADV          00:00:02
P26  TEMP INPUT (1-8)              03
P26  TEMP SCALE 0=C 1=F            00
P26  *TEMP FORMAT               000.0
P26  MEAS INTERVAL           00:15:00        AVERAGE
P26  START OF MEAS           13:15:00
P26  LEVEL 1 MEAS TYPE            002
```

```
P26 LEVEL 1 SAMP INTVL 00:00:20        LOG
P26 LVL1 DATA SET SIZE    00045
P26 LEVEL 2 MEAS TYPE       001
P26 XMIT 2 OR 3 BYTES?       03
P26 HIGH LIMIT          NO LIMIT
P26 LOW LIMIT           NO LIMIT
P26 HIGH DIFF LIMIT     NO LIMIT
P26 LOW DIFF LIMIT      NO LIMIT
P   CHANNEL NO.              28        RELATIVE HUMIDITY
P28 SENSOR TYPE              04
P28 SENSOR NAME TAG          04
P28 CARD SLOT #              02
P28 SENSOR PWR ADV      00:00:02
P28 HUMIDITY CHAN (1,2)      01
P28 *FULL SCALE             500
P28 ZERO SCALE              000
P28 MEAS INTERVAL       00:15:00
P28 START OF MEAS       13:15:00       AVERAGE
P28 LEVEL 1 MEAS TYPE       002
P28 LEVEL 1 SAMP INTVL 00:00:22
P28 LVL1 DATA SET SIZE    00040        LOG
P28 LEVEL 2 MEAS TYPE       001
P28 XMIT 2 OR 3 BYTES?       03
P28 HIGH LIMIT          NO LIMIT
P28 LOW LIMIT           NO LIMIT
P28 HIGH DIFF LIMIT     NO LIMIT
P28 LOW DIFF LIMIT      NO LIMIT
P   CHANNEL NO.              36        TEMPERATURE
P36 SENSOR TYPE              03
P36 SENSOR NAME TAG          03
P36 CARD SLOT #              02
P36 SENSOR PWR ADV      00:00:02
P36 TEMP INPUT (1-8)         02
P36 TEMP SCALE 0=C 1=F       00
P36 *TEMP FORMAT          000.0
P36 MEAS INTERVAL       00:15:00
P36 START OF MEAS       13:15:00       AVERAGE
P36 LEVEL 1 MEAS TYPE       002
P36 LEVEL 1 SAMP INTVL 00:00:20
P36 LVL1 DATA SET SIZE    00045        LOG
P36 LEVEL 2 MEAS TYPE       001
P36 XMIT 2 OR 3 BYTES?       03
P36 HIGH LIMIT          NO LIMIT
P36 LOW LIMIT           NO LIMIT
P36 HIGH DIFF LIMIT     NO LIMIT
P36 LOW DIFF LIMIT      NO LIMIT
P   CHANNEL NO.              38        RELATIVE HUMIDITY
P38 SENSOR TYPE              04
P38 SENSOR NAME TAG          04
P38 CARD SLOT #              02
P38 SENSOR PWR ADV      00:00:02
P38 HUMIDITY CHAN (1,2)      02
P38 *FULL SCALE             500
P38 ZERO SCALE              000
P38 MEAS INTERVAL       00:15:00
```

```
P38 START OF MEAS       13:15:00        AVERAGE
P38 LEVEL 1 MEAS TYPE        002
P38 LEVEL 1 SAMP INTVL 00:00:22
P38 LVL1 DATA SET SIZE     00040        LOG
P38 LEVEL 2 MEAS TYPE        001
P38 XMIT 2 OR 3 BYTES?        03
P38 HIGH LIMIT          NO LIMIT
P38 LOW LIMIT           NO LIMIT
P38 HIGH DIFF LIMIT     NO LIMIT
P38 LOW DIFF LIMIT      NO LIMIT
P   CHANNEL NO.               41        WIND SPEED
P41 SENSOR TYPE               01
P41 SENSOR NAME TAG           01
P41 CARD SLOT #               02
P41 SENSOR PWR ADV      00:00:02
P41 *SENS THRESHOLD        000.0
P41 FREQ/VEL (XX.XXX)     00.586
P41 MEAS INTERVAL       00:05:00
P41 START OF MEAS       13:15:00        AVERAGE
P41 LEVEL 1 MEAS TYPE        002
P41 LEVEL 1 SAMP INTVL 00:00:03
P41 LVL1 DATA SET SIZE     00100        LOG
P41 LEVEL 2 MEAS TYPE        001
P41 XMIT 2 OR 3 BYTES?        03
P41 HIGH LIMIT          NO LIMIT
P41 LOW LIMIT           NO LIMIT
P41 HIGH DIFF LIMIT     NO LIMIT
P41 LOW DIFF LIMIT      NO LIMIT
P   CHANNEL NO.               43        WIND DIRECTION
P43 SENSOR TYPE               02
P43 SENSOR NAME TAG           02
P43 CARD SLOT #               02
P43 SENSOR PWR ADV      00:00:02
P43 WD: 0=POLAR 1=RECT        00
P43 *FULL SCALE              359
P43 ZERO SCALE               000
P43 MEAS INTERVAL       00:05:00
P43 START OF MEAS       13:15:00        AVERAGE
P43 LEVEL 1 MEAS TYPE        002
P43 LEVEL 1 SAMP INTVL 00:00:01
P43 LVL1 DATA SET SIZE     00300        LOG
P43 LEVEL 2 MEAS TYPE        001
P43 SECONDARY CHANNEL         00
P43 XMIT 2 OR 3 BYTES?        03
P   CHANNEL NO.               44        WIND DIRECTION
P44 SENSOR TYPE               02
P44 SENSOR NAME TAG           02
P44 CARD SLOT #               02
P44 SENSOR PWR ADV      00:00:02
P44 WD: 0=POLAR 1=RECT        00
P44 *FULL SCALE            359.9
P44 ZERO SCALE             000.0
P44 MEAS INTERVAL       00:05:00
P44 START OF MEAS       13:15:00        STANDARD DEVIATION
P44 LEVEL 1 MEAS TYPE        003
P44 LEVEL 1 SAMP INTVL 00:00:01
```

```
P44 LVL1 DATA SET SIZE      00300         LOG
P44 LEVEL 2 MEAS TYPE         001
P44 SECONDARY CHANNEL          00
P44 XMIT 2 OR 3 BYTES?         03
P   CHANNEL NO.                46         TEMPERATURE
P46 SENSOR TYPE                03
P46 SENSOR NAME TAG            03
P46 CARD SLOT #                02
P46 SENSOR PWR ADV       00:00:02
P46 TEMP INPUT (1-8)           01
P46 TEMP SCALE 0=C 1=F         00
P46 *TEMP FORMAT            000.0
P46 MEAS INTERVAL        00:15:00
P46 START OF MEAS        13:15:00         AVERAGE
P46 LEVEL 1 MEAS TYPE         002
P46 LEVEL 1 SAMP INTVL 00:00:20
P46 LVL1 DATA SET SIZE      00045         LOG
P46 LEVEL 2 MEAS TYPE         001
P46 XMIT 2 OR 3 BYTES?         03
P46 HIGH LIMIT           NO LIMIT
P46 LOW LIMIT            NO LIMIT
P46 HIGH DIFF LIMIT      NO LIMIT
P46 LOW DIFF LIMIT       NO LIMIT
P   CHANNEL NO.                51         WIND SPEED
P51 SENSOR TYPE                01
P51 SENSOR NAME TAG            01
P51 CARD SLOT #                03
P51 SENSOR PWR ADV       00:00:02
P51 *SENS THRESHOLD         000.0
P51 FREQ/VEL (XX.XXX)      00.586
P51 MEAS INTERVAL        00:05:00
P51 START OF MEAS        13:15:00         AVERAGE
P51 LEVEL 1 MEAS TYPE         002
P51 LEVEL 1 SAMP INTVL 00:00:03
P51 LVL1 DATA SET SIZE      00100         LOG
P51 LEVEL 2 MEAS TYPE         001
P51 XMIT 2 OR 3 BYTES?         03
P51 HIGH LIMIT           NO LIMIT
P51 LOW LIMIT            NO LIMIT
P51 HIGH DIFF LIMIT      NO LIMIT
P51 LOW DIFF LIMIT       NO LIMIT
P   CHANNEL NO.                53         WIND DIRECTION
P53 SENSOR TYPE                02
P53 SENSOR NAME TAG            02
P53 CARD SLOT #                03
P53 SENSOR PWR ADV       00:00:02
P53 WD: 0=POLAR 1=RECT         00
P53 *FULL SCALE               359
P53 ZERO SCALE                000
P53 MEAS INTERVAL        00:05:00
P53 START OF MEAS        13:15:00         AVERAGE
P53 LEVEL 1 MEAS TYPE         002
P53 LEVEL 1 SAMP INTVL 00:00:01
```

```
P53 LVL1 DATA SET SIZE     00300        LOG
P53 LEVEL 2 MEAS TYPE        001
P53 SECONDARY CHANNEL         00
P53 XMIT 2 OR 3 BYTES?        03
P   CHANNEL NO.               54        WIND DIRECTION
P54 SENSOR TYPE               02
P54 SENSOR NAME TAG           02
P54 CARD SLOT #               03
P54 SENSOR PWR ADV      00:00:02
P54 WD: 0=POLAR 1=RECT        00
P54 *FULL SCALE            359.9
P54 ZERO SCALE             000.0
P54 MEAS INTERVAL       00:05:00
P54 START OF MEAS       13:15:00        STANDARD DEVIATION
P54 LEVEL 1 MEAS TYPE        003
P54 LEVEL 1 SAMP INTVL  00:00:01
P54 LVL1 DATA SET SIZE     00300        LOG
P54 LEVEL 2 MEAS TYPE        001
P54 SECONDARY CHANNEL         00
P54 XMIT 2 OR 3 BYTES?        03
P   CHANNEL NO.               56        TEMPERATURE
P56 SENSOR TYPE               03
P56 SENSOR NAME TAG           03
P56 CARD SLOT #               03
P56 SENSOR PWR ADV      00:00:02
P56 TEMP INPUT (1-8)          01
P56 TEMP SCALE 0=C 1=F        00
P56 *TEMP FORMAT           000.0
P56 MEAS INTERVAL       00:15:00
P56 START OF MEAS       13:15:00        AVERAGE
P56 LEVEL 1 MEAS TYPE        002
P56 LEVEL 1 SAMP INTVL  00:00:20
P56 LVL1 DATA SET SIZE     00045        LOG
P56 LEVEL 2 MEAS TYPE        001
P56 XMIT 2 OR 3 BYTES?        03
P56 HIGH LIMIT          NO LIMIT
P56 LOW LIMIT           NO LIMIT
P56 HIGH DIFF LIMIT     NO LIMIT
P56 LOW DIFF LIMIT      NO LIMIT
P   CHANNEL NO.               61        WIND SPEED
P61 SENSOR TYPE               01
P61 SENSOR NAME TAG           01
P61 CARD SLOT #               04
P61 SENSOR PWR ADV      00:00:02
P61 *SENS THRESHOLD        000.0
P61 FREQ/VEL (XX.XXX)     00.586
P61 MEAS INTERVAL       00:05:00
P61 START OF MEAS       13:15:00        AVERAGE
P61 LEVEL 1 MEAS TYPE        002
P61 LEVEL 1 SAMP INTVL  00:00:03
P61 LVL1 DATA SET SIZE     00100        LOG
P61 LEVEL 2 MEAS TYPE        001
P61 XMIT 2 OR 3 BYTES?        03
P61 HIGH LIMIT          NO LIMIT
P61 LOW LIMIT           NO LIMIT
P61 HIGH DIFF LIMIT     NO LIMIT
P61 LOW DIFF LIMIT      NO LIMIT
```

P	CHANNEL NO.	63	WIND DIRECTION
P63	SENSOR TYPE	02	
P63	SENSOR NAME TAG	02	
P63	CARD SLOT #	04	
P63	SENSOR PWR ADV	00:00:02	
P63	WD: 0=POLAR 1=RECT	00	
P63	*FULL SCALE	359	
P63	ZERO SCALE	000	
P63	MEAS INTERVAL	00:05:00	
P63	START OF MEAS	13:15:00	AVERAGE
P63	LEVEL 1 MEAS TYPE	002	
P63	LEVEL 1 SAMP INTVL	00:00:01	
P63	LVL1 DATA SET SIZE	00300	LOG
P63	LEVEL 2 MEAS TYPE	001	
P63	SECONDARY CHANNEL	00	
P63	XMIT 2 OR 3 BYTES?	03	
P	CHANNEL NO.	64	WIND DIRECTION
P64	SENSOR TYPE	02	
P64	SENSOR NAME TAG	02	
P64	CARD SLOT #	04	
P64	SENSOR PWR ADV	00:00:02	
P64	WD: 0=POLAR 1=RECT	00	
P64	*FULL SCALE	359.9	
P64	ZERO SCALE	000.0	
P64	MEAS INTERVAL	00:05:00	
P64	START OF MEAS	13:15:00	STANDARD DEVIATION
P64	LEVEL 1 MEAS TYPE	003	
P64	LEVEL 1 SAMP INTVL	00:00:01	
P64	LVL1 DATA SET SIZE	00300	LOG
P64	LEVEL 2 MEAS TYPE	001	
P64	SECONDARY CHANNEL	00	
P64	XMIT 2 OR 3 BYTES?	03	
P	CHANNEL NO.	66	TEMPERATURE
P66	SENSOR TYPE	03	
P66	SENSOR NAME TAG	03	
P66	CARD SLOT #	04	
P66	SENSOR PWR ADV	00:00:02	
P66	TEMP INPUT (1-8)	01	
P66	TEMP SCALE 0=C 1=F	00	
P66	*TEMP FORMAT	000.0	
P66	MEAS INTERVAL	00:15:00	
P66	START OF MEAS	13:15:00	AVERAGE
P66	LEVEL 1 MEAS TYPE	002	
P66	LEVEL 1 SAMP INTVL	00:00:20	
P66	LVL1 DATA SET SIZE	00045	LOG
P66	LEVEL 2 MEAS TYPE	001	
P66	XMIT 2 OR 3 BYTES?	03	
P66	HIGH LIMIT	NO LIMIT	
P66	LOW LIMIT	NO LIMIT	
P66	HIGH DIFF LIMIT	NO LIMIT	
P66	LOW DIFF LIMIT	NO LIMIT	

```
P    ID                      00000001         ******************
P    STATION TIME            08:24:29         *                *
P    YEAR  (XX)                    87         *   Type 4 540A  *
P    DCP JULIAN DATE              014         *     Program    *
P    GMT  TIME  NOT IMPLEMENTED               *     01-15-87   *
P    DIFT TIME NOT IMPLEMENTED YET            *                *
P    TIMED REPORT TYPE             00         ******************
P    SEC REPORT TYPE               00
P    COMMUNICATION TYPE            00
P    MAX MESSAGE LENGTH           512
P    TEL #:AREA CODE            0-000
P    TEL #:LOCAL             000-0000
P    DIAL OUT FORMAT               00
P    DIAL IN FORMAT                00
P    PROG TIME (1=Y,0=N)           00
P    1ST DIAL TIME           00:00:00
P    DIAL INTERVAL           00:00:00
P    TEL EMG XMIT 1=ON             00
P    AUTO DUMP? 1=Y 0=N            00
P    1ST LOG TIME            00:00:00
P    LOG INTERVAL            00:00:00
P    DRIVE MODE                    00
P    LOG MODE                      00
P    VOICE OUTPUT MODE             00
P    TOUCH TONE PASSWD              0
P    CHANNEL NO.                   01
P01  SENSOR TYPE                   12       BATTERY VOLTAGE
P01  SENSOR NAME TAG               12
P01  MEAS INTERVAL           00:15:00
P01  START OF MEAS           08:30:00
P01  LEVEL 1 MEAS TYPE            002       AVERAGE
P01  LEVEL 1 SAMP INTVL      00:01:00
P01  LVL1 DATA SET SIZE         00015
P01  LEVEL 2 MEAS TYPE            001       LOG DATA
P01  XMIT 2 OR 3 BYTES?            03
P01  HIGH LIMIT              NO LIMIT
P01  LOW LIMIT               NO LIMIT
P01  HIGH DIFF LIMIT         NO LIMIT
P01  LOW DIFF LIMIT          NO LIMIT
P    CHANNEL NO.                   02
P02  SENSOR TYPE                   10       CAL. SIGNAL
P02  SENSOR NAME TAG               10
P02  CARD SLOT #                   02
P02  SENSOR INPUT ADRS              A
P02  SENSOR PWR ADRS                8
P02  SENSOR PWR ADV          00:00:02
P02  *FULL SCALE                5.000
P02  ZERO SCALE                 0.000
P02  MEAS INTERVAL           00:15:00
P02  START OF MEAS           08:30:00
P02  LEVEL 1 MEAS TYPE            002       AVERAGE
P02  LEVEL 1 SAMP INTVL      00:00:10
P02  LVL1 DATA SET SIZE         00090
```

P02 LEVEL 2 MEAS TYPE	001	LOG
P02 XMIT 2 OR 3 BYTES?	03	
P02 HIGH LIMIT	NO LIMIT	
P02 LOW LIMIT	NO LIMIT	
P02 HIGH DIFF LIMIT	NO LIMIT	
P02 LOW DIFF LIMIT	NO LIMIT	
P CHANNEL NO.	03	
P03 SENSOR TYPE	10	NO (AIR QUALITY)
P03 SENSOR NAME TAG	10	
P03 CARD SLOT #	02	
P03 SENSOR INPUT ADRS	9	
P03 SENSOR PWR ADRS	8	
P03 SENSOR PWR ADV	00:00:02	
P03 *FULL SCALE	5.000	
P03 ZERO SCALE	0.000	
P03 MEAS INTERVAL	00:05:00	
P03 START OF MEAS	08:30:00	
P03 LEVEL 1 MEAS TYPE	002	AVERAGE
P03 LEVEL 1 SAMP INTVL	00:00:10	
P03 LVL1 DATA SET SIZE	00030	
P03 LEVEL 2 MEAS TYPE	001	LOG
P03 XMIT 2 OR 3 BYTES?	03	
P03 HIGH LIMIT	NO LIMIT	
P03 LOW LIMIT	NO LIMIT	
P03 HIGH DIFF LIMIT	NO LIMIT	
P03 LOW DIFF LIMIT	NO LIMIT	
P CHANNEL NO.	07	
P07 SENSOR TYPE	10	O_3 (AIR QUALITY)
P07 SENSOR NAME TAG	10	
P07 CARD SLOT #	02	
P07 SENSOR INPUT ADRS	8	
P07 SENSOR PWR ADRS	8	
P07 SENSOR PWR ADV	00:00:02	
P07 *FULL SCALE	5.000	
P07 ZERO SCALE	0.000	
P07 MEAS INTERVAL	00:05:00	
P07 START OF MEAS	08:30:00	
P07 LEVEL 1 MEAS TYPE	002	AVERAGE
P07 LEVEL 1 SAMP INTVL	00:00:10	
P07 LVL1 DATA SET SIZE	00030	
P07 LEVEL 2 MEAS TYPE	001	LOG
P07 XMIT 2 OR 3 BYTES?	03	
P07 HIGH LIMIT	NO LIMIT	
P07 LOW LIMIT	NO LIMIT	
P07 HIGH DIFF LIMIT	NO LIMIT	
P07 LOW DIFF LIMIT	NO LIMIT	
P CHANNEL NO.	08	
P08 SENSOR TYPE	10	SO_2 (AIR QUALITY)
P08 SENSOR NAME TAG	10	
P08 CARD SLOT #	03	
P08 SENSOR INPUT ADRS	4	
P08 SENSOR PWR ADRS	8	
P08 SENSOR PWR ADV	00:00:02	
P08 *FULL SCALE	5.000	
P08 ZERO SCALE	0.000	
P08 MEAS INTERVAL	00:05:00	
P08 START OF MEAS	08:30:00	

```
P08 LEVEL 1 MEAS TYPE       002        AVERAGE
P08 LEVEL 1 SAMP INTVL 00:00:10
P08 LVL1 DATA SET SIZE    00030
P08 LEVEL 2 MEAS TYPE       001        LOG
P08 XMIT 2 OR 3 BYTES?       03
P08 HIGH LIMIT         NO LIMIT
P08 LOW LIMIT          NO LIMIT
P08 HIGH DIFF LIMIT    NO LIMIT
P08 LOW DIFF LIMIT     NO LIMIT
P   CHANNEL NO.              09
P09 SENSOR TYPE              10        NOx (AIR QUALITY)
P09 SENSOR NAME TAG          10
P09 CARD SLOT #              03
P09 SENSOR INPUT ADRS         5
P09 SENSOR PWR ADRS           8
P09 SENSOR PWR ADV     00:00:02
P09 *FULL SCALE           5.000
P09 ZERO SCALE            0.000
P09 MEAS INTERVAL      00:05:00
P09 START OF MEAS      08:30:00
P09 LEVEL 1 MEAS TYPE       002        AVERAGE
P09 LEVEL 1 SAMP INTVL 00:00:10
P09 LVL1 DATA SET SIZE    00030
P09 LEVEL 2 MEAS TYPE       001        LOG
P09 XMIT 2 OR 3 BYTES?       03
P09 HIGH LIMIT         NO LIMIT
P09 LOW LIMIT          NO LIMIT
P09 HIGH DIFF LIMIT    NO LIMIT
P09 LOW DIFF LIMIT     NO LIMIT
P   CHANNEL NO.              26        TEMPERATURE
P26 SENSOR TYPE              03
P26 SENSOR NAME TAG          03
P26 CARD SLOT #              02
P26 SENSOR PWR ADV     00:00:02
P26 TEMP INPUT (1-8)         03
P26 TEMP SCALE 0=C 1=F       00
P26 *TEMP FORMAT          000.0
P26 MEAS INTERVAL      00:15:00
P26 START OF MEAS      08:30:00
P26 LEVEL 1 MEAS TYPE       002        AVERAGE
P26 LEVEL 1 SAMP INTVL 00:00:20
P26 LVL1 DATA SET SIZE    00045
P26 LEVEL 2 MEAS TYPE       001        LOG
P26 XMIT 2 OR 3 BYTES?       03
P26 HIGH LIMIT         NO LIMIT
P26 LOW LIMIT          NO LIMIT
P26 HIGH DIFF LIMIT    NO LIMIT
P26 LOW DIFF LIMIT     NO LIMIT
P   CHANNEL NO.              28
```

```
P28 SENSOR TYPE              04       RELATIVE HUMIDITY
P28 SENSOR NAME TAG          04
P28 CARD SLOT #              02
P28 SENSOR PWR ADV     00:00:02
P28 HUMIDITY CHAN (1,2)      01
P28 *FULL SCALE             500
P28 ZERO SCALE              000
P28 MEAS INTERVAL      00:15:00
P28 START OF MEAS      08:30:00
P28 LEVEL 1 MEAS TYPE       002       AVERAGE
P28 LEVEL 1 SAMP INTVL 00:00:22
P28 LVL1 DATA SET SIZE    00040
P28 LEVEL 2 MEAS TYPE       001       LOG
P28 XMIT 2 OR 3 BYTES?       03
P28 HIGH LIMIT         NO LIMIT
P28 LOW LIMIT          NO LIMIT
P28 HIGH DIFF LIMIT    NO LIMIT
P28 LOW DIFF LIMIT     NO LIMIT
P   CHANNEL NO.              36
P36 SENSOR TYPE              03       TEMPERATURE
P36 SENSOR NAME TAG          03
P36 CARD SLOT #              02
P36 SENSOR PWR ADV     00:00:02
P36 TEMP INPUT (1-8)         02
P36 TEMP SCALE 0=C 1=F       00
P36 *TEMP FORMAT          000.0
P36 MEAS INTERVAL      00:15:00
P36 START OF MEAS      08:30:00
P36 LEVEL 1 MEAS TYPE       002       AVERAGE
P36 LEVEL 1 SAMP INTVL 00:00:20
P36 LVL1 DATA SET SIZE    00045
P36 LEVEL 2 MEAS TYPE       001       LOG
P36 XMIT 2 OR 3 BYTES?       03
P36 HIGH LIMIT         NO LIMIT
P36 LOW LIMIT          NO LIMIT
P36 HIGH DIFF LIMIT    NO LIMIT
P36 LOW DIFF LIMIT     NO LIMIT
P   CHANNEL NO.              38
P38 SENSOR TYPE              04       RELATIVE HUMIDITY
P38 SENSOR NAME TAG          04
P38 CARD SLOT #              02
P38 SENSOR PWR ADV     00:00:02
P38 HUMIDITY CHAN (1,2)      02
P38 *FULL SCALE             500
P38 ZERO SCALE              000
P38 MEAS INTERVAL      00:15:00
P38 START OF MEAS      08:30:00
P38 LEVEL 1 MEAS TYPE       002       AVERAGE
P38 LEVEL 1 SAMP INTVL 00:00:22
P38 LVL1 DATA SET SIZE    00040
P38 LEVEL 2 MEAS TYPE       001       LOG
P38 XMIT 2 OR 3 BYTES?       03
P38 HIGH LIMIT         NO LIMIT
P38 LOW LIMIT          NO LIMIT
P38 HIGH DIFF LIMIT    NO LIMIT
P38 LOW DIFF LIMIT     NO LIMIT
P   CHANNEL NO.              41
```

P41 SENSOR TYPE	01	WIND SPEED
P41 SENSOR NAME TAG	01	
P41 CARD SLOT #	02	
P41 SENSOR PWR ADV	00:00:02	
P41 *SENS THRESHOLD	000.0	
P41 FREQ/VEL (XX.XXX)	00.586	
P41 MEAS INTERVAL	00:05:00	
P41 START OF MEAS	08:30:00	
P41 LEVEL 1 MEAS TYPE	002	AVERAGE
P41 LEVEL 1 SAMP INTVL	00:00:03	
P41 LVL1 DATA SET SIZE	00100	
P41 LEVEL 2 MEAS TYPE	001	LOG
P41 XMIT 2 OR 3 BYTES?	03	
P41 HIGH LIMIT	NO LIMIT	
P41 LOW LIMIT	NO LIMIT	
P41 HIGH DIFF LIMIT	NO LIMIT	
P41 LOW DIFF LIMIT	NO LIMIT	
P CHANNEL NO.	43	
P43 SENSOR TYPE	02	WIND DIRECTION
P43 SENSOR NAME TAG	02	
P43 CARD SLOT #	02	
P43 SENSOR PWR ADV	00:00:02	
P43 WD: 0=POLAR 1=RECT	00	
P43 *FULL SCALE	359	
P43 ZERO SCALE	000	
P43 MEAS INTERVAL	00:05:00	
P43 START OF MEAS	08:30:00	
P43 LEVEL 1 MEAS TYPE	002	AVERAGE
P43 LEVEL 1 SAMP INTVL	00:00:01	
P43 LVL1 DATA SET SIZE	00300	
P43 LEVEL 2 MEAS TYPE	001	LOG
P43 SECONDARY CHANNEL	00	
P43 XMIT 2 OR 3 BYTES?	03	
P CHANNEL NO.	44	
P44 SENSOR TYPE	02	WIND DIRECTION
P44 SENSOR NAME TAG	02	
P44 CARD SLOT #	02	
P44 SENSOR PWR ADV	00:00:02	
P44 WD: 0=POLAR 1=RECT	00	
P44 *FULL SCALE	359.9	
P44 ZERO SCALE	000.0	
P44 MEAS INTERVAL	00:05:00	
P44 START OF MEAS	08:30:00	
P44 LEVEL 1 MEAS TYPE	003	STANDARD DEVIATION
P44 LEVEL 1 SAMP INTVL	00:00:01	
P44 LVL1 DATA SET SIZE	00300	
P44 LEVEL 2 MEAS TYPE	001	LOG
P44 SECONDARY CHANNEL	00	
P44 XMIT 2 OR 3 BYTES?	03	
P CHANNEL NO.	46	

P46	SENSOR TYPE	03	TEMPERATURE
P46	SENSOR NAME TAG	03	
P46	CARD SLOT #	02	
P46	SENSOR PWR ADV	00:00:02	
P46	TEMP INPUT (1-8)	01	
P46	TEMP SCALE 0=C 1=F	00	
P46	*TEMP FORMAT	000.0	
P46	MEAS INTERVAL	00:15:00	
P46	START OF MEAS	08:30:00	
P46	LEVEL 1 MEAS TYPE	002	AVERAGE
P46	LEVEL 1 SAMP INTVL	00:00:20	
P46	LVL1 DATA SET SIZE	00045	
P46	LEVEL 2 MEAS TYPE	001	LOG
P46	XMIT 2 OR 3 BYTES?	03	
P46	HIGH LIMIT	NO LIMIT	
P46	LOW LIMIT	NO LIMIT	
P46	HIGH DIFF LIMIT	NO LIMIT	
P46	LOW DIFF LIMIT	NO LIMIT	
P	CHANNEL NO.	51	
P51	SENSOR TYPE	01	WIND SPEED
P51	SENSOR NAME TAG	01	
P51	CARD SLOT #	03	
P51	SENSOR PWR ADV	00:00:02	
P51	*SENS THRESHOLD	000.0	
P51	FREQ/VEL (XX.XXX)	00.586	
P51	MEAS INTERVAL	00:05:00	
P51	START OF MEAS	08:30:00	
P51	LEVEL 1 MEAS TYPE	002	AVERAGE
P51	LEVEL 1 SAMP INTVL	00:00:03	
P51	LVL1 DATA SET SIZE	00100	
P51	LEVEL 2 MEAS TYPE	001	LOG
P51	XMIT 2 OR 3 BYTES?	03	
P51	HIGH LIMIT	NO LIMIT	
P51	LOW LIMIT	NO LIMIT	
P51	HIGH DIFF LIMIT	NO LIMIT	
P51	LOW DIFF LIMIT	NO LIMIT	
P	CHANNEL NO.	53	
P53	SENSOR TYPE	02	WIND DIRECTION
P53	SENSOR NAME TAG	02	
P53	CARD SLOT #	03	
P53	SENSOR PWR ADV	00:00:02	
P53	WD: 0=POLAR 1=RECT	00	
P53	*FULL SCALE	359	
P53	ZERO SCALE	000	
P53	MEAS INTERVAL	00:05:00	
P53	START OF MEAS	08:30:00	
P53	LEVEL 1 MEAS TYPE	002	AVERAGE
P53	LEVEL 1 SAMP INTVL	00:00:01	
P53	LVL1 DATA SET SIZE	00300	
P53	LEVEL 2 MEAS TYPE	001	LOG
P53	SECONDARY CHANNEL	00	
P53	XMIT 2 OR 3 BYTES?	03	
P	CHANNEL NO.	54	

P54 SENSOR TYPE	02	WIND DIRECTION
P54 SENSOR NAME TAG	02	
P54 CARD SLOT #	03	
P54 SENSOR PWR ADV	00:00:02	
P54 WD: 0=POLAR 1=RECT	00	
P54 *FULL SCALE	359.9	
P54 ZERO SCALE	000.0	
P54 MEAS INTERVAL	00:05:00	
P54 START OF MEAS	08:30:00	
P54 LEVEL 1 MEAS TYPE	003	STANDARD DEVIATION
P54 LEVEL 1 SAMP INTVL	00:00:01	
P54 LVL1 DATA SET SIZE	00300	
P54 LEVEL 2 MEAS TYPE	001	LOG
P54 SECONDARY CHANNEL	00	
P54 XMIT 2 OR 3 BYTES?	03	
P CHANNEL NO.	56	
P56 SENSOR TYPE	03	TEMPERATURE
P56 SENSOR NAME TAG	03	
P56 CARD SLOT #	03	
P56 SENSOR PWR ADV	00:00:02	
P56 TEMP INPUT (1-8)	01	
P56 TEMP SCALE 0=C 1=F	00	
P56 *TEMP FORMAT	000.0	
P56 MEAS INTERVAL	00:15:00	
P56 START OF MEAS	08:30:00	
P56 LEVEL 1 MEAS TYPE	002	AVERAGE
P56 LEVEL 1 SAMP INTVL	00:00:20	
P56 LVL1 DATA SET SIZE	00045	
P56 LEVEL 2 MEAS TYPE	001	LOG
P56 XMIT 2 OR 3 BYTES?	03	
P56 HIGH LIMIT	NO LIMIT	
P56 LOW LIMIT	NO LIMIT	
P56 HIGH DIFF LIMIT	NO LIMIT	
P56 LOW DIFF LIMIT	NO LIMIT	
P CHANNEL NO.	61	
P61 SENSOR TYPE	01	WIND SPEED
P61 SENSOR NAME TAG	01	
P61 CARD SLOT #	04	
P61 SENSOR PWR ADV	00:00:02	
P61 *SENS THRESHOLD	000.0	
P61 FREQ/VEL (XX.XXX)	00.586	
P61 MEAS INTERVAL	00:05:00	
P61 START OF MEAS	08:30:00	
P61 LEVEL 1 MEAS TYPE	002	AVERAGE
P61 LEVEL 1 SAMP INTVL	00:00:03	
P61 LVL1 DATA SET SIZE	00100	
P61 LEVEL 2 MEAS TYPE	001	LOG
P61 XMIT 2 OR 3 BYTES?	03	
P61 HIGH LIMIT	NO LIMIT	
P61 LOW LIMIT	NO LIMIT	
P61 HIGH DIFF LIMIT	NO LIMIT	
P61 LOW DIFF LIMIT	NO LIMIT	
P CHANNEL NO.	63	

P63 SENSOR TYPE	02	WIND DIRECTION
P63 SENSOR NAME TAG	02	
P63 CARD SLOT #	04	
P63 SENSOR PWR ADV	00:00:02	
P63 WD: 0=POLAR 1=RECT	00	
P63 *FULL SCALE	359	
P63 ZERO SCALE	000	
P63 MEAS INTERVAL	00:05:00	
P63 START OF MEAS	08:30:00	
P63 LEVEL 1 MEAS TYPE	002	AVERAGE
P63 LEVEL 1 SAMP INTVL	00:00:01	
P63 LVL1 DATA SET SIZE	00300	
P63 LEVEL 2 MEAS TYPE	001	LOG
P63 SECONDARY CHANNEL	00	
P63 XMIT 2 OR 3 BYTES?	03	
P CHANNEL NO.	64	
P64 SENSOR TYPE	02	WIND DIRECTION
P64 SENSOR NAME TAG	02	
P64 CARD SLOT #	04	
P64 SENSOR PWR ADV	00:00:02	
P64 WD: 0=POLAR 1=RECT	00	
P64 *FULL SCALE	359.9	
P64 ZERO SCALE	000.0	
P64 MEAS INTERVAL	00:05:00	
P64 START OF MEAS	08:30:00	
P64 LEVEL 1 MEAS TYPE	003	STANDARD DEVIATION
P64 LEVEL 1 SAMP INTVL	00:00:01	
P64 LVL1 DATA SET SIZE	00300	
P64 LEVEL 2 MEAS TYPE	001	LOG
P64 SECONDARY CHANNEL	00	
P64 XMIT 2 OR 3 BYTES?	03	
P CHANNEL NO.	66	
P66 SENSOR TYPE	03	TEMPERATURE
P66 SENSOR NAME TAG	03	
P66 CARD SLOT #	04	
P66 SENSOR PWR ADV	00:00:02	
P66 TEMP INPUT (1-8)	01	
P66 TEMP SCALE 0=C 1=F	00	
P66 *TEMP FORMAT	000.0	
P66 MEAS INTERVAL	00:15:00	
P66 START OF MEAS	08:30:00	
P66 LEVEL 1 MEAS TYPE	002	AVERAGE
P66 LEVEL 1 SAMP INTVL	00:00:20	
P66 LVL1 DATA SET SIZE	00045	
P66 LEVEL 2 MEAS TYPE	001	LOG
P66 XMIT 2 OR 3 BYTES?	03	
P66 HIGH LIMIT	NO LIMIT	
P66 LOW LIMIT	NO LIMIT	
P66 HIGH DIFF LIMIT	NO LIMIT	
P66 LOW DIFF LIMIT	NO LIMIT	

Chapter V
CHAWS COMPUTER SYSTEM

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Environmental Sciences Division

1.0 INTRODUCTION

The CHAWS computer system has many functions and is comprised of a number of separate but interrelated computers, software, and peripheral devices (Fig. V-1). These are grouped by function below.

1.1 Hardware architecture

An IBM PC/AT computer is used as the heart of the system. It contains ALLOY slave cards, which are semi-autonomous computers themselves. The PC/AT is called the host and each slave is called a user. Normally each user has its own specific function.

1.2 System software

The operating system used for the CHAWS system is IBM PC DOS Version 3.1 or higher. In addition, ATNX from Alloy Computer Products, Inc. is used to communicate with the PC slave cards and to administer system resources such as hard disk, floppy-disk drives, and printers.

1.3 System functions

The following functions are accomplished by the use of a combination of hardware and software.

1.3.1 Weather data acquisition

Meteorological information is collected from remote weather stations, displayed on a computer screen, and stored on the host computer's hard disk for future use.

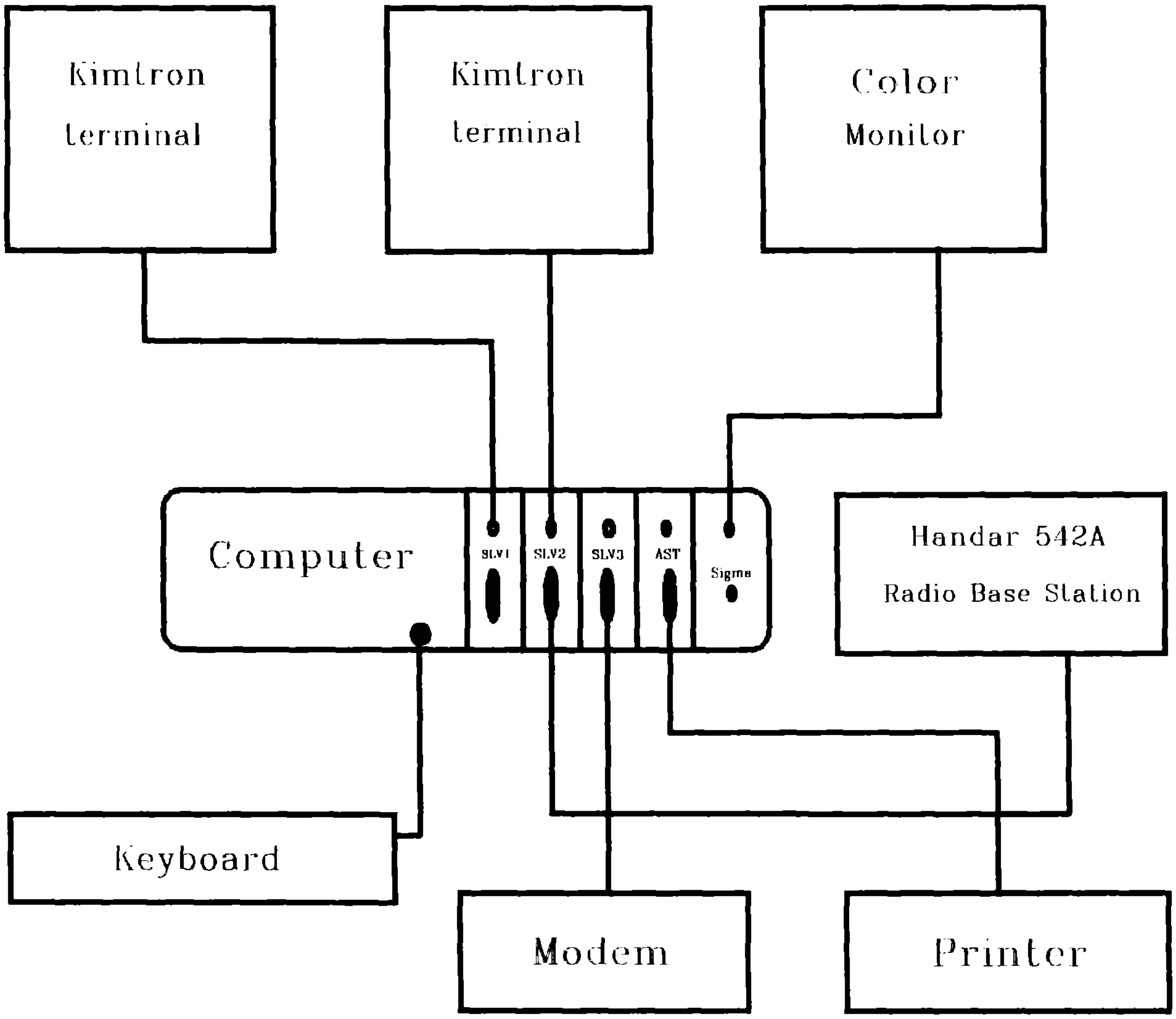

Figure V-1. Pine Bluff CHAWS computer system.

1.3.2 Modeling, hazard prediction, and graphics

The acquired weather data are utilized by a number of programs to predict hazard dispersion and to give a visual representation of wind speed, wind direction, temperature, etc.

1.3.3 Report writing

The CHAWS computer system may be used to generate reports based on the acquired weather data. Such reports could include AQ summaries, local weather reports, and so on.

2.0 OPERATIONS

The following procedures may be used in the day-to-day operations of the CHAWS computer system. (Refer to Chapter I for additional considerations in daily operations.)

2.1 Cold Start

To start the entire system from a powered-down condition:

1. Apply power to all computers and peripherals in the CHAWS Computer System.

2. Be sure that all components are on and working properly. (The power lights for each component should now be on, and all software modules should be running and performing their jobs properly.)

3. If the software that is supposed to run on any user is not running, or if any piece of equipment fails to operate, consult 3.0, Troubleshooting.

2.2 The IBM PC/AT host computer

All other users depend on the host computer. A momentary loss of power or rebooting the host will reset all other users. The host may be used to run almost any software (consult the "PC-Plus User's Guide" and the "ATNX Installation Guide" for exceptions). It has, however, two primary functions:

1. It provides hard disk, printer, and communications for all other users. This is accomplished through the use of the ATNX operating system, which is installed automatically when the system is reset if the standard CHAWS AUTOEXEC.BAT is in place on the computer's hard disk.

2. The second function is to perform downwind hazard prediction and to provide a graphics presentation of the results. Consult Chapter VI for details of these functions.

2.3 Routine weather-data logging

2.3.1 Normal base station program execution

The weather data-acquisition computer will start running BASE.EXE, the HANDAR radio base station software, when it is powered up or rebooted if the standard CHAWS autoexec files are in place on the computer's hard disk. This program will put the system in the data polling mode. If not, consult section 3.0, Troubleshooting.

2.3.2 Starting the base station program

If the radio base station program has been stopped for any reason, it may be restarted by rebooting the data-acquisition computer. This is done by pressing the <Ctrl><Alt><Del> keys on its keyboard simultaneously. The same result may be obtained by terminating any applications software that may be running on the data-acquisition computer. When the DOS prompt appears, type "cd\slave" <Enter>, followed by "base -a900" <Enter>. If data logging does not commence at the next even 15-minute interval, see 3.0, Troubleshooting.

2.3.3 Returning the base station program to the "poll/monitor" mode

If the radio base station software is in a menu other than "Poll/Monitor mode", press <F10> until the main menu appears. Now press <F2> from the main menu. The polling menu should now be on the screen. The message "Polling enabled" should be in the upper center screen. If not, and if no polls are pending, the procedures described in 2.3.2 may be used to start polling. Should it be undesirable to do this, consult the HANDAR manual.

2.4 Telephone communications

Depending on the configuration of your system, telephone communications may be used to share data with other computers and/or obtain data from other devices, such as the SODAR system.

2.4.1 Initiating telephone communications with a dedicated system

If telephone communications are handled by a dedicated slave card, it is necessary only to turn the system on for this program to begin. The easiest way to reset this program is to reboot its slave. If no terminal is connected to this slave, it may be reset from any other user by typing "\slvreset n" <Enter>, where "n" is the number of that slave card.

2.4.2 Initiating telephone communications with a shared system

If telephone communications are performed by the host or a slave card that has more than one function, it may be necessary to invoke the communication software. See Appendix V-A for an example of this procedure.

2.5 SODAR data logging

If a SODAR system is installed, this function is handled automatically by the telephone communications module. See Appendix V-B for more information.

2.6 Streaming-tape backup system

The streaming-tape system should be used to back up the entire contents of the hard disk on your system from time to time. It may also be used to archive historical data.

Read the manual(s) for this product and familiarize yourself with its use. If the Everex streaming-tape system is used, perform the following procedures:

2.6.1 Prepare the system

Place the CHAWS installation disk in Drive A of the computer to be backed up. Wait until all data logging is complete for the current 15-minute period and reboot the PC/AT host computer. Place a blank tape or a tape with unwanted data in the streaming-tape drive.

2.6.2 Backup/restore procedure

1. If files are being restored to a freshly formatted hard disk, it will be necessary to prepare the disk. Do not proceed with step 1 if the hard disk has not been formatted. Type "a:prepdisk c:" <Enter> while the CHAWS installation disk is still in drive A. Next, place the EVEREX software disk in drive A and type "md c:\evtape" <Enter>. Now type "copy a:*.* c:\evtape" <Enter> and copy all of the Everex diskettes to this directory. Finally, type "md c:\spldir" <Enter>.

2. Type "c:" <Enter>, "cd\evtape" <Enter>, "tape" <Enter>.

3. From the main menu, select the desired action, either backup or restore, in the file-by-file mode.

4. In both cases, select the subdirectory option. DO NOT allow existing files or system files to be overwritten when restoring the hard disk.

2.6.3 Return the computer to the CHAWS system

Open the door on drive A and reboot the system by pressing the <Ctrl><Alt><Del> keys on the host PC/AT simultaneously.

2.7 Using the printer

When the ATNX operating system is installed, the printer(s) connected to the system are placed under the control of a program called SPOOL.COM. To use this tool effectively, read Section 4, Print Management, in the "PC-Plus User's Guide."

Briefly, any document that is printed by applications software may be sent to the printer by first pressing the <Alt> and the <F10> keys simultaneously. After the print menu appears at the bottom of the screen, press <Enter>, which must be done on the terminal that printed the document.

A file may be printed directly from the hard disk by typing "\spool" and the name of the file to be printed, followed by <Enter>. To print a file directly from a directory other than the one you are in, type "\spool [drive name]:\[directory name]\[filename]", followed by <Enter>. For example, "\spool c:\handar\printer.dat" <Enter>.

A user can use the system printer exclusively for direct printing by pressing <Ctrl>-"p" while in the D2 directory. Type "d2pc" PRIOR to pressing <Enter>; press <Ctrl>-"p", and then press <Enter>. When you no longer desire to have direct printing, press <Ctrl>-"p" again.

3.0 TROUBLESHOOTING GUIDE

The following is a list of potential problems and their possible solutions.

3.1 <u>System power problems</u>

All or part of the system has no power. Power indicator lights are out.

1. Be sure that equipment has not been accidentally unplugged or turned off.

2. Check the integrity of all circuit breakers and fuses for that part of the system. Reset or replace the affected breaker or fuse.

3. Some power-conditioning equipment will power down during a "brown out" or power loss. If your system is so equipped, reset this device.

4. If an uninterruptible power supply (UPS) has been installed, try bypassing it by plugging the affected equipment directly into a 120-V receptacle. If this corrects the problem, read the UPS manual to be sure it is being used correctly. If so, have it serviced.

3.2 Default software does not start when system is powered up or rebooted

Be sure that the computer has booted from the hard disk. The door on drive A should be open, and the host should be running "LOGIT". To verify this, type <Ctrl> "c". A message should appear which asks "Terminate batch job (Y/N)?". Type "n" to continue or "y" to quit, followed by <Enter>.

If the door on drive A is closed, open it and reboot.
If the computer does not boot, refer to 3.3.

If the computer boots but the expected software is not running, copy all pertinent files to the affected computer as follows:

1. Place the CHAWS installation disk in drive A. Close the drive A door. Type "c:" <Enter>, "cd\" <Enter>, "a:install" <Enter>. Wait until the last file is copied onto the hard disk before proceeding.

2. Open drive A and reboot the system. If the problem still exists, refer to 3.3.

3.3 Hard-disk problems

If the computer will not boot from the hard disk, fails to run standard software packages, or displays disk errors, perform the following procedures:

3.3.1 Use of the IBM diagnostic software to identify the problem

Place the CHAWS installation diskette in drive A and reboot the system. Now place the IBM diagnostic diskette in drive A and close the drive door. Press the <Ctrl><Alt><Del> keys simultaneously to reboot the system, and wait for the diagnostic menu to appear.

1. Select option "0", system checkout. Compare the list of peripherals on the screen with those on your system. Type "y" <Enter> if the list is correct.

2. Now select option "0" and run test once. Open the door on drive A and press <Enter>. Follow all subsequent directions. If an error in group 1700 occurs, have your hard disk serviced. If not, proceed with 3.3.2.

3.3.2 Find lost clusters and corrupted files

1. Place the CHAWS system backup diskette in drive A and close the door. Reboot the system.

2. Type "c:" <Enter>, "a:chkdsk /f" <Enter>, "n" <Enter>. A list of files with cross-linked clusters may be displayed. If so, delete these files by typing "del [directory name]\[filename.extension]" <Enter> for each file listed. For example, such a file may be listed as "C:\HANDAR\RAWDAT.DAT". To delete this file, the operator would type "del c:\handar\rawdat.dat" <Enter>. If the operator is unsure whether these files should be deleted, they may be copied to a new filename prior to deleting the original file.

3. Type "a:" <Enter>, "sys c:" <Enter>.

4. Type "c:" <Enter>, "a:install" <Enter>.

5. When all of the files are copied, open the door on drive A and reboot the system. If the problem is fixed, stop; if not, proceed with 3.3.3.

3.3.3 Formatting the system hard disk

The following procedure should not be used unless absolutely necessary. All of the data on your hard disk will be destroyed. If possible, back up the entire hard disk onto floppy disks or streaming tape by using the file-by-file method. This procedure may be necessary from time to time in order to improve hard-disk performance.

1. Back up all important files such as data files and non-CHAWS software.

2. Place your CHAWS system disk in drive A, close the door, and reboot the system.

3. WARNING: THE FOLLOWING PROCEDURE WILL DESTROY ALL DATA ON YOUR HARD DISK. Type "format c:/s" <Enter>, "y" <Enter>. If any error message appears, have the system serviced.

4. When formatting is complete, type "c:" <Enter>. With the CHAWS installation disk in drive A, type "a:install" <Enter>. When the DOS prompt appears, open the door on drive A and reboot the system.

If the system is functioning correctly, restore any other files you were able to back up. If the system still does not function, have it serviced.

3.4 Telephone communications

If telephone communication problems exist between the CHAWS system and other computers, be sure that all equipment is connected properly and that power is applied to the modem. If these are all correct, try the following:

1. Be sure that MEX-PC is using the same serial port to which your modem is connected. For a slave card, this will always be COM2:. For the host computer, it will usually be COM1:.

2. Unplug and replug the modem's power cord from/to the UPS. Turning it off and on may not reset it. To test the modem, run the MEX program. Now type "at" <Enter>. If an "OK" is returned, then communications exist between the modem and the computer. Try the procedure that previously failed one more time.

3. If the "OK" prompt was not received above, then connect a new modem to the system in exactly the same manner that the old one was connected. Repeat procedure 3.4.2.

    a. If the new modem does not work, connect the serial line from the modem to a different user and run the modem software on that user.

        1) If this works, then the serial port on the first user is defective and must be replaced.

2) If the second user does not communicate with the new modem, replace the serial cable and/or adapters.

b. If the new modem works, then have the old modem repaired.

4. If the modem and serial port are functioning properly, connect a telephone handset to the telephone line used for the modem.

a. If there is no dial tone, or the telephone will not support two-way communications with another phone, have the telephone line repaired.

b. If the telephone line, modem, and computer seem to be working, replace the RJ-11 line between the modem and the wall connector.

4.0 SYSTEM INSTALLATION AND SPECIFICATIONS

This section is supplied primarily as a reference. The CHAWS system should have already been installed.

All hardware should be installed in a clean environment, with a temperature range of between 60 and 80°F and a noncondensing relative humidity of 20 to 80%.

Power supplies for all computers must be surge protected.

4.1 Uninterruptible Power Supply (UPS)

Connect the power cable of each UPS to a 120-V, 20-A, 60-Hz circuit. If needed, connect a power-distribution strip to one of its output sockets. Do not use any type of surge suppression between the UPS and the computer or peripheral device. Do not overload the UPS. If it has a rating of 1.0 kVA, then a load of no more than 8.3 A may be placed on it. The lower the load, the longer the UPS will function when line power is lost.

4.2 Computers

Place all computers and peripherals in a cool, well-ventilated area. Follow the manufacturer's recommendations for installation. Be sure that all power connections are made to either a surge protector or to a UPS.

4.3 Base station

Follow the instructions in the HANDAR "Operating and Service Manual for Interrogated Radio Systems" to install all HANDAR base station equipment.

4.3.1 Radio base station

If used, install the HANDAR 542 radio base station near the data-acquisition computer. Connect its power cord to the UPS. Attach the antenna coaxial cable to the DIN connector in back. Now connect the serial cable to the 25-pin "D" connector in back of the radio base station.

4.3.2 Direct telephone system

If a HANDAR direct telephone connection is used, install the central station IF card in an empty slot in the data-acquisition (host) computer. Attach the modular telephone connector to the plug provided. Attach a serial cable between the 25-pin "D" connector on the IF card and a serial port on the host computer (either COM1 or COM2).

4.3.3 Connecting base station to computer

A special 25-pin cable adapter should be installed on COM2 of the PC/Slave before connecting the serial cable from the base station to the slave card. The adapter is needed to prevent line 22, ring indicator, from being connected to the slave. COM2 on the PC/Slave card is the 25-pin "D" connector.

4.4 PC/slave card installation

Use the "ATNX Installation Guide" and "PC-PLUS User's Guide" to perform the following procedures.

4.4.1 PC/slave card setup

1. Enter the same base address for all users in this system with the dip switches located on each slave card. The locations for the correct bank

of dip switches and the corresponding settings are found in the ATNX guide. The default value is 220.

2. Set the user number for each card with the dip switches located on each slave.

3. Set the amount of memory on each card with the first set of dip switches.

4. Install the math co-processor (PC Math 16) on the slave card that is to be used for data processing.

4.4.2 PC/slave card installation

Install the slave card(s) in empty slot(s) in the host PC/AT computer or on its expansion chassis (if used) in any empty slot.

Attach a monitor cable to each slave's 9-pin connector and to an appropriate monitor. This will usually be a Kimtron KT/7 PC.

4.4.3 PC/slave card system software installation

Place the CHAWS installation disk in drive A of the host PC/AT and reboot the system. Type "install" <Enter>. This will place the slave ATNX operating system on the hard disk along with the rest of the CHAWS system.

If a new slave card has been added to the system, it may be necessary to tell the system it is there. This can be done by running a program called "NXCNFG". Consult the "ATNX Installation Guide" for this procedure.

4.5 Expansion chassis

If an expansion chassis is used with the host computer, install it according to the manufacturer's instructions.

4.6 Telephone Modem

The telephone modem must be connected to COM2/LOC1 of the slave card that will be used for this purpose or to COM1 of the host computer if a slave is not used. Use a 25-pin serial cable and a special 25-pin adapter to make this connection to a slave, or a 9-pin/25-pin cable if the host is used. The adapter is needed to prevent line 22, ring indicator, from being connected to the slave. Follow the modem manufacturer's instructions for installing and programming the modem.

5.0 LIST OF MANUALS NEEDED FOR CHAPTER V

1. IBM Disk Operating System, IBM Corp. and Microsoft, Inc.

2. PC-PLUS User's Guide, Alloy Computer Products, Inc.

3. ATNX Installation Guide, Alloy Computer Products, Inc.

4. Model KT-7/PC Terminal Operator's Manual, Kimtron Corporation.

5. Modem operations manual.

6. Everex streaming tape backup system, Owners Manual, Everex Systems, Inc.

7. Evcel Streaming 60 tape backup system, Installation Guide, Everex Systems, Inc.

8. Operating and Service Manual for Interrogated Radio Systems, HANDAR, Inc., Sunnyvale, CA 94089.

9. 540A-1 Multiple Access Data Acquisition System Operating and Service Manual, HANDAR, Inc., Sunnyvale, CA 94089.

Appendix V-A: Shared Telephone Communications

The following example is for the system currently used at Tooele Army Depot.

1. Terminate the current software package according to the instructions for its use.

2. From the D2PC directory, type "mex read strinp" <Enter>. Telephone communications are now enabled. Use the MEX-PC manual for instructions on how to use this software for other applications.

3. To terminate the telephone communications program, press the <Ctrl> and "c" keys simultaneously several times. When the "MEX>" prompt appears, type "dos", <Enter>. Any other software package may now be run.

Appendix V-B: SODAR/Telephone Communications

The following is a description of the telephone communications protocol at CHAWS sites having SODAR units. They are designed so that one telephone may call the SODAR at 15-minute intervals and receive incoming calls the rest of the time. In addition to these main functions, other jobs may be assigned as well, on a site-by-site basis.

SODAR/telephone slave (SLV 3)

When this slave is booted, it runs a program called MEX.COM (Modem EXecutive). This program reads a script file called SODAR.MEX, which causes the SODAR to be called and polled. The SODAR data is put into a file called SODAR.DAT and into a daily file with a name like 085_S87.DAT, where 085 is the Julian date, _S stands for SODAR, and 87 is the year.

After the SODAR data has been logged, a secondary program called WAIT_ANS.EXE is run by MEX.COM. This causes the modem to be monitored for incoming calls. When the correct password is received from the modem, a file corresponding to this password will be sent. These passwords and file names are stored in a file called PASSWRD.CFG, which looks like this:

```
3                       !  number of passwords
PBA or EDG              !  first password, site dependent
LATEST                  !  second password
SODAR                   !  third password
C:/HANDAR/TEMP1.DAT     !  first file
C:/LATEST/LATEST.DAT    !  second file
C:/SODAR/SODAR.DAT      !  third file
```

Communication parameters for this program are stored in a file called WAITCOM.CFG, which looks like this:

```
COM2                    ! communications port used
1200                    ! baud rate
,N,8,1,CS0,DS0,CD0      ! communication parameters
3                       ! telephone slave #
MEX READ SODAR          ! file to execute at time-out
```

The modem will be monitored until one minute after the next quarter hour. When this time runs out, WAIT_ANS ends, and MEX.COM resumes. It will go to the beginning of SODAR.MEX, and the cycle repeats with another call to the SODAR unit.

Chapter VI
GRAPHIC DISPLAY AND DATA PROCESSING SOFTWARE

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1.0 PURPOSE

This section describes the programs needed to convert HANDAR meteorological and MONITOR LABS AQ analyzer data to valid hourly averages. It also explains how to operate real-time, high-resolution graphics that display recent meteorology on the host computer's screen. Finally, it describes methods of tabulating and archiving the data and reporting requested AQ data to government agencies.

1.1 Overview

How do we convert data from the raw signals output by the meteorological sensors and air quality analyzers to valid hourly averages of measured parameters? The answer to this question is displayed in the flowchart in Figure VI-1 and discussed below. It is also described in detail in the other chapters.

Section 1.2 summarizes the software discussed; Section 2 describes in detail what each program does; Section 3 describes how to run the programs; and Section 4 discusses how to interpret and use the results and provides procedures for archiving the data. The regular daily operation of the CHAWS system continuous software is discussed in Chapter I of this manual.

Abbreviations throughout this volume are explained when they are first used in each section, as well as in the first two tables. Some common ones include AQ for air quality, CAL for calibration mode or calibration reference value, Ch for channel, QA for quality assurance, Met for meteorological, WX for short-term data files (5- or 15-min average data), HR for hour files, HLY for hourly, jul for Julian date, mon for month, yr for year, and I/P and O/P for input and output, respectively. Brackets "[]" appearing in filenames are not used in the actual files. They designate non-generic data that depend on the particular date for the file in question.

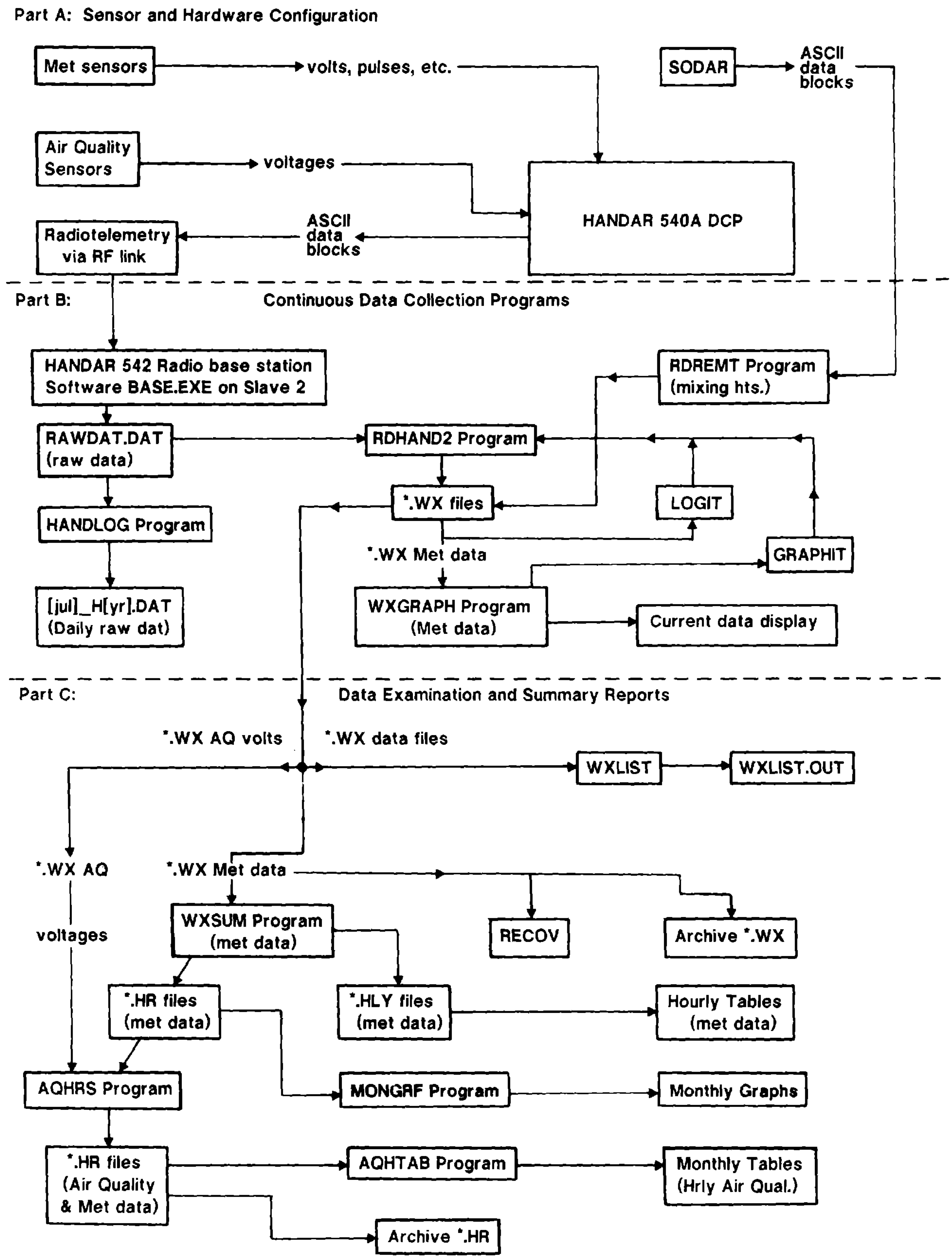

Figure VI-1. CHAWS data train and software flow chart.

1.2 Summary

Each sensor generates a voltage, series of pulses, or other signal related to the value of the parameter it is monitoring. This "raw" value is converted to digital data, and transmitted via radiotelemetry to a central location. (Details of this acquisition and transmission are discussed in Chapters II through V and in UCID-20988.) Then the data are quality-checked, displayed if requested, and averaged by a series of programs discussed in this chapter.

The data-processing software flowchart is illustrated in Figure VI-1, and the major programs are listed in Table VI-1. The first series of programs runs continuously in a real-time mode and handles the gathering of immediate (short-term) data. These programs are run by using either the LOGIT or the GRAPHIT batch files (depending on whether or not a graphic display is desired). The second series of programs averages and handles long-term data (hourly and longer averages) and is run on an as-needed basis. These programs are started manually, but most are of the "turnkey" variety and require little input. They average the short-term data into hourly averages and determine the primary and secondary maxima and means for longer periods. Other manually operated programs that appear to branch off in the figure are for quality assurance (QA) and data recovery analysis. They are not required for data reduction but are recommended for QA.

2.0 DATA FILE AND PROGRAM DESCRIPTIONS

This section describes the role of each data file and each program in the data processing "train". It also describes what each program does in the order of their operation. A summary of the programs, functions, files used, and their locations is presented in Table VI-1.

2.1 Data files

A number of different storage files are used to store raw, short-term edited, and hourly average values for use in the data processing and presentation software. These files are listed in Table VI-2. Each file in the table appears in its place in the data train shown in Figure VI-1. Data stored in RAWDAT.DAT and the *.WX files contain 5- and 15-minute average

Table VI-1. SOFTWARE SUMMARY

\Directory\ Program.ext	Purpose	Limitations	Input \directory \files	Output \directory \files
HANDAR 540A internal	Single Station Data Processing	MET volts translated and avg; AQ in volts	Raw MET/AQ signals for data	ASCII data blocks
\RAWDAT\ BASE.EXE	Base Station Data Gathering	No quality assurance (QA)	\SLAVE\DELTCNF.CFG (ASCII data blocks)	\RAWDAT\ RAWDAT.DAT
\RAWDAT\ HANDLOG.EXE	Daily raw data file storage	Use for year end (1st 5 days new year)	\HANDAR\RAWDAT.DAT (ASCII data blocks)	\HANDAR\ [jul]_H[yr].DAT
LOGIT.BAT @ or \HANDAR\ RDHAND2.EXE	Transfer data from RAWDAT.DAT to *.WX; some QA	Quality Assurance for MET data but not for Air Quality	\RAWDAT\RAWDAT.DAT \HANDAR\WXCONF.CNF	\WXOBS\ *.WX
GRAPHIT.BAT @ or \HANDAR\ WXGRAPH.EXE	Graphic Display of MET values and wind trajec.	No Air Quality data Displays. MET data only; need AQHTAB	\WXOBS*.WX \HANDAR\WXCD.FIL \HANDAR\WXGRAPH.INI	\WXOBS\ *.HR, \WXOBS\ *.WX
\HANDAR\ WXLIST.EXE	Create Listing of 5-min avg. AQ & wind values & 15-min avg. Temp and RH vals	AQ voltages NOT yet translated. For parts per billion, multiply voltages by 100.	\WXOBS*.WX \HANDAR\WXCD.FIL \HANDAR\WXLIST.INI \HANDAR\WXLIST.PRE \HANDAR\WXCONF.CNF	\HANDAR\WXLIST.OUT, \HANDAR\WXLIST.XXX

Table VI-1. SOFTWARE SUMMARY - Contd.

\HANDAR\ WXSUM.EXE	Create files and tables of hourly averaged MET data and AQ voltages	AQ voltages NOT yet translated. For parts per billion, multiply voltages by 100.	\WXOBS*.WX \HANDAR\WXCD.FIL, \HANDAR\WXSUM.INI \HANDAR\WXCONF.CNF \HANDAR\HRCONF.CNF	\WXOBS\ *.HR, \WXOBS\ *.HLY, MESSAGES.XXX
AQHRS.BAT or \AQCAL\ AQHRS.EXE	Translate AQ voltages to ppb & elim. CAL's	Does not do CAL ZERO or SPAN drift checks	\WXOBS*.WX, *.HR \HANDAR\WXCONF.CNF \HANDAR\HRCONF.CNF	\WXOBS\ *.HR (w/conv AQ data) AQHRS.XXX
\AQCAL\ AQHTAB.EXE	Create monthly AQ table(s)	From 1 to 16 Tables Generated per month	\WXOBS\ *.HR \HANDAR\HRCONF.CNF	\AQCAL\ AQ[monyr].TAB
\AQCAL\ AQCAL.EXE	Find ZERO and SPAN values for daily CAL's	Stations must be synchronized; no drift checks done	\WXOBS\ *.WX \HANDAR\WXCONF.CNF	\AQCAL\ AQCAL[yr].TXT MESSAGES.XXX

@ Note: Batch files and programs with this "@" symbol can be run from the root directory.

ABBREVIATIONS -- DEFINITIONS

AQ -- Air Quality
Avg -- Average (Mean) Value(s)
CAL -- Calibration (may refer to a ZERO or SPAN value)
Ed -- Edit or Editing to eliminate bad data
I/P -- Input of data
MET -- Meteorological data or systems
O/P -- Output of data
QA -- Quality Assurance
Temp -- Temperature
RH -- Relative Humidity
Val -- Value
Vrbl -- Variable

(For actual definition of unfamiliar terms, see Glossary -- Appendix B)

Table VI-2. Data files used and created.

Filename	Exten. name	Program Creating	Description of Contents	Format @	Files per yr	Bytes per file
RAWDAT.	DAT	BASE	Raw, Uned. data file	ASCII	Temp (N/A)	variable
[jul]_H[yr].	DAT	HANDLOG, HANDLOGS	Daily Raw data files	ASCII	365	276,000
T[julyr]T2.	WX	RDHAND2	5- & 15-min MET,AQ Avg	Dir Ac Binary	365	67,200
WXLIST.	OUT	WXLIST	5- & 15-min MET,AQ Avg	ASCII	12	variable
T[julyr]T2.	HR	WXSUM	Hourly MET,AQ Avg	Dir Ac Binary	365	7,584
T[julyr]T2.	HLY	WXSUM	Hourly Avg MET Tables	ASCII	365	32,704
AQHR.	TAB	AQHTAB (1 Ch)	Monthly AQ data by hr	ASCII	12	variable
AQ[monyr].	TAB	AQHTAB (2-16 Ch)	Monthly AQ data by hr	ASCII	12	variable
AQCAL[yr].	TXT	AQCAL	Daily CAL ZERO, SPAN	ASCII	1	85,405

NOTE: ASCII files can be edited on the screen, printed, or typed with the DOS "type" command. This cannot be done with binary files, but they are the most efficient means of storage.

ABBREVIATIONS -- DEFINITIONS (in addition to those included with Table VI-1)

Ch -- Data channel for CHAWS system.
Dir Ac -- Direct access
jul -- 3-digit Julian date (starting with Jan. 1)
Uned -- Data not been edited for QA
yr -- Last two digits of year

(For full definitions of unfamiliar terms, see the Glossary in Appendix I-A.)

values of meteorological parameters and untranslated voltages that represent AQ values. Data stored in the *.HR files consist of hourly average values. AQ voltages on these *.HR files are not translated to parts per billion (ppb) until AQHRS is run.

For easy identification, the names of all edited data files include the letter "T" followed by five numbers for the Julian date and year, two characters for the configuration type, and an extension describing the file type. For example, the data for Tooele Army Depot South for June 17, 1986 are stored in the raw file "T16886T2.WX", where 168 is the Julian date, 86 is for 1986, and T2 is the configuration type. Julian dates are given by month in Appendix I-C. Hourly data would have the same filename but a different extension name (*.HR, see Table VI-2).

2.2 Configuration and initialization files

To run certain software, either configuration, initialization, or preset files are used (see Table VI-3). These provide the program with input specific to the particular site. The WXCONF.CNF file, for instance, provides information on the various channels of data and their respective locations and averaging periods. It also provides RDHAND2 with a range of reasonable values for the meteorological parameters. Important: *.CNF files are not to be altered without prior authorization from personnel at LLNL.

The initialization files (*.INI) provide the program with site-specific information or tell it what parameters to use to determine the output display type and layout, number of tables or graphs, etc. They can be edited with PE2 (Section 3.4). You may alter these files to fit the needs of a particular run.

The WXGRAPH.INI file contains information regarding the colors, scale, and parameters to be displayed on the WXGRAPH screen (see Section 3.1.7).

The WXLIST.INI and WXSUM.INI files contain information regarding screen colors and other options for running their respective programs--WXLIST and WXSUM (see Sections 3.2.1 and 3.2.2).

The AQHTAB initialization file AQHTAB.INI tells the AQHTAB program to create tables for certain stations and pollutants. It provides site-specific information to the AQHTAB program and identifies the AQ station numbers by providing a unique name for each station at a given site.

Table VI-3. Configuration, initialization, preset and help files used.

\Directory\ filename	Exten. name	Program Using	Description of Contents	Format
\SLAVE\ DELTCNF.	CFG	BASE	Contains Poll Parameters	Binary
\HANDAR\ WXCONF.	CNF	Any using *.WX file	Met., AQ Sta. & Ch. QA Param.	ASCII
\HANDAR\ HRCONF.	CNF	Any using *.HR file	Met., AQ Sta. & Ch. Config.	ASCII
\HANDAR\ WXGRAPH.	INI	WXGRAPH, RDWXGINI	Graphics Settings	ASCII
\HANDAR\ WXLIST.	INI	WXLIST	Screen Settings	ASCII
\HANDAR\ WXLIST.	PRE	WXLIST	Station and Channel presets	ASCII
\HANDAR\ WXLIST.	HLP	WXLIST	Hit F1 key for this help menu	ASCII
\HANDAR\ WXSUM.	INI	WXSUM	Screen Settings	ASCII
\HANDAR\ WXSUM.	HLP	WXSUM	Hit F1 key for this help menu	ASCII
\HANDAR\ PE2.	PRO	PE2	Screen, Margin Settings	ASCII
\HANDAR\ PE2.	HLP	PE2	Hit F1 key for this help menu	ASCII
\AQCAL\ AQHTAB.	INI	AQHTAB	Output Table Specifications	ASCII

The preset file WXLIST.PRE provides the WXLIST program with preset station and channel combinations that are commonly requested by the user.

The preset file PE2.PRO defines the function keys (F1, F2 etc.), sets the margins, and presets various other tasks to make it easier to use PE2.

The help files (*.HLP) provide the user with simple instructions to help run the programs. They usually explain the function of certain keystrokes. While not necessarily recommended without talking to personnel at LLNL, the user may edit these files using PE2. They can be read by striking the <F1> key from their respective programs.

The WXSUM.HLP file explains the keystroke commands to assist a user with running WXSUM.

The PE2.HLP file displays the keystroke commands used for running PE2. It need not be modified by the user.

2.3 Continuous data-collection programs

This section describes the software designed to operate continuously on the CHAWS data-acquisition system. The essential software will run automatically once the system is booted. Software for high-resolution graphics of recent meteorology requires a simple command to start (GRAPHIT).

2.3.1 Single-station signal processing and averaging software

As seen in Figure VI-1, there is a HANDAR 540A Data Collection Platform (DCP) at each station. This platform collects voltages, pulses, or other signals from each sensor. It includes an instruction set that translates the meteorological sensor voltages to meteorological units. It then sends these ASCII values to the HANDAR Base Station via the radiotelemetry system discussed in Chapter IV.

2.3.2 Base station software (BASE.EXE)

Note from Figure VI-1 that ASCII data blocks are fed directly from each station's signal-processing software to the HANDAR 542 Radio Base Station via RF link. The purpose of BASE.EXE is to collect these ASCII data blocks and store them as daily files (RAWDAT.DAT) containing unedited 5- and 15-minute average parameter values. Meanwhile, it also displays them on the Kimtron terminal screen as they are collected. The BASE.EXE program can also be used to reprogram the HANDAR 540A DCPs.

2.3.3 Batch file for logging without display (LOGIT.BAT)

This batch file runs RDHAND2.EXE (see 2.3.6) every 15 minutes for data transfer from the RAWDAT.DAT file to the *.WX files without graphic display.

2.3.4 Batch file for logging with display (GRAPHIT.BAT)

This batch file runs WXGRAPH.EXE (see 2.3.7). If the WXGRAPH.INI file is set for real-time operation (see 3.1.6), it calls routines every 15 minutes for data transfer from the RAWDAT.DAT file to the *.WX files as well as the other WXGRAPH routines for graphic display.

2.3.5 Logging of the raw data files (HANDLOG.EXE)

This program creates daily files of the RAWDAT data for storage in case a user is unsure about the data base. Because these ASCII files "[jul]H[yr].DAT" are huge (see Table VI-2), creating them is not recommended unless absolutely necessary. Because permanent storage consumes a lot of time and space, only temporary storage is recommended. For permanent storage, use the *.WX files, as they are much more efficient with storage space (see 4.4.1).

2.3.6 Program for logging without display (RDHAND2.EXE)

This program copies all the data from the RAWDAT.DAT files to the direct-access binary *.WX files on hard disk. It is run by the batch file LOGIT.BAT (see above) for continuous transfer of data without graphic display or by GRAPHIT.BAT when graphic display is included.

In addition to data transfer, RDHAND2 does some preliminary QA editing by screening out values of meteorological parameters above or below certain limits. These limits are specified for each instrument in the configuration file WXCONF.CNF, which is read by RDHAND2. No preliminary QA is performed on the AQ data, however, nor is it transformed from volts to concentrations.

2.3.7 Program for graphic display (WXGRAPH.EXE)

This program uses high-resolution color graphics to continuously update and display the latest weather data on the host computer's screen. It is designed for single-cycle operation but may be called by GRAPHIT for continuous operation if the review mode is specified as FALSE (see 3.1.6). When in the review mode, it can display data from any data period that has been stored in the *.WX files. It has been updated to include inversion depictions from the SODAR system.

The WXGRAPH program draws the site map using the available information from WXCONF.CNF and WXGRAPH.INI. Depending on the review-mode status, it then will either run continuously with data from the latest 15-minute period or display historic data for the specified time period.

The date and ending time of the display being drawn are typed across the bottom of the screen and the latest wind direction arrows are placed at each station. Then trajectories are drawn, starting at selected locations with different colors for the different start times. A sample screen-dump printout appears as Figure VI-2.

The trajectories consist of a series of arrows (triangles) or circles for each 5-minute period and are calculated by analyzing 5-minute average wind data. They may be thought of as plots of successive positions of the center of mass released at a specified location. The release time is calculated by subtracting the time length of the trajectory from the time appearing at the bottom of the screen. WXGRAPH uses all available wind data in a "one over distance squared" method to approximate wind between stations. The trajectory arrow is pointed downwind, except where the wind speed is less than 1 m/s, in which case the symbol is an open circle.

Next, WXGRAPH draws several time series graphs on the right side of the screen. The data traces have time on the horizontal axis from left to right and feature the last few hours of wind direction, wind speed, and temperature from any set of stations. A site-wide average of all the stations may also be drawn.

CAUTIONS:

- The WXGRAPH wind trajectories may appear misleading to the untrained eye. When viewing them, please remember that they represent the path of a prior

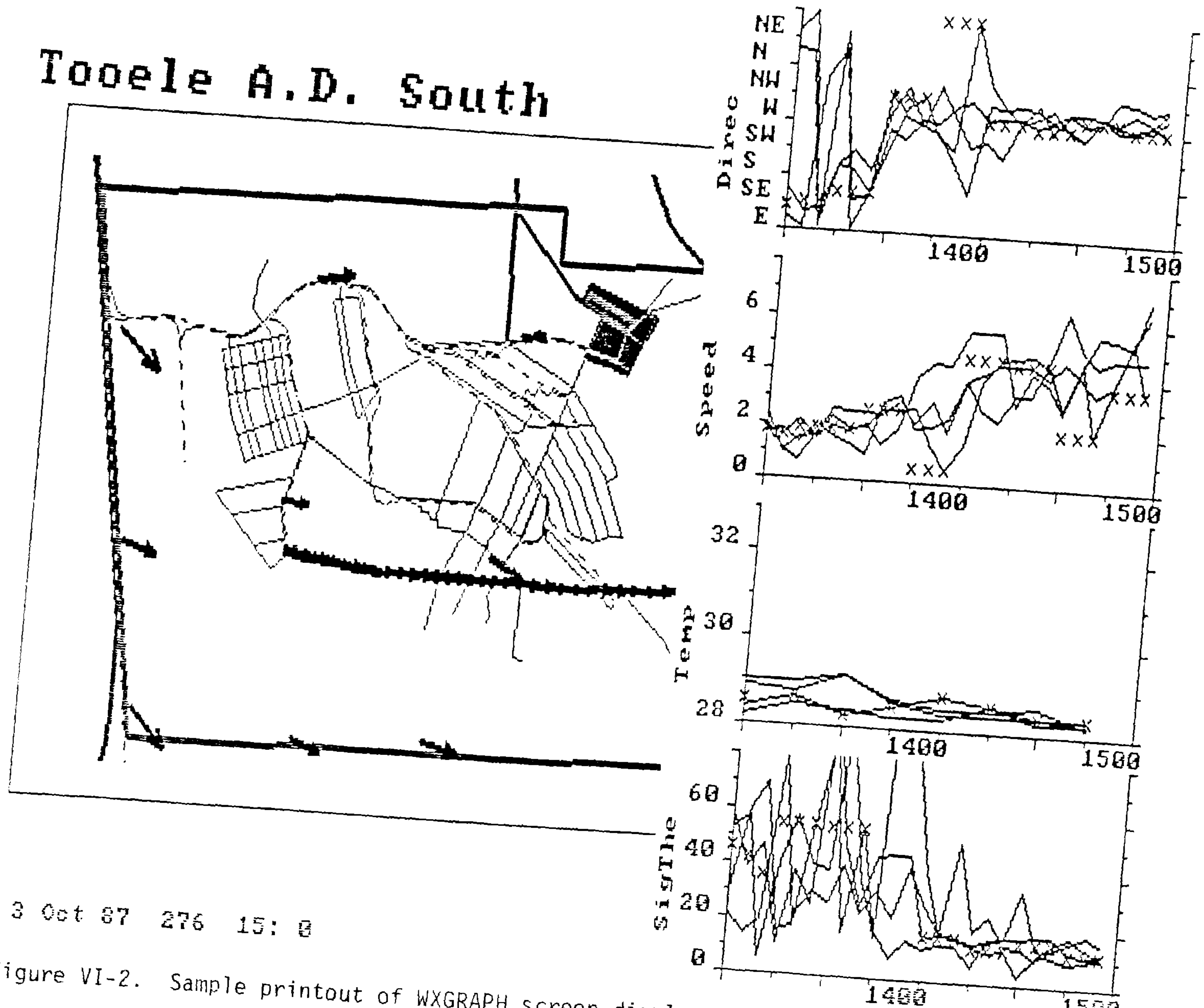

Figure VI-2. Sample printout of WXGRAPH screen display.

puff released at the start of the period and do not represent an instantaneous snapshot plume from a continuous release or the future path or a current release.

- When a station has no wind report, the trajectory algorithm does not advance the trajectory symbol for that station. When this happens, the trajectory symbol stalls on the screen.

2.4 Data examination and summary programs

The software described in this section is used to study, reduce, and archive the data base. Data are processed and tables are created. Detailed examination and use of these tables are described in section 4.2.

2.4.1 WXLIST

This is the immediate, short-term data listing program for the CHAWS system. It enables the operator to view the 5- and 15-minute weather data (or AQ voltages) stored in the *.WX files. Data can be output to three devices: the screen, a file, and the printer. This will be the handiest program for examination of the short-term data base within the last few hours.

2.4.2 The Hourly Averaging Program (WXSUM)

The WXSUM program reads meteorological parameters and AQ voltages off the *.WX files and averages them. It can create two types of files -- *.HR and *.HLY -- for storage and/or for printing the averages out as tables. The files created have similar names to the *.WX files except for the extensions (see Table VI-2). While the *.WX and *.HR files are in direct access binary format, the *.HLY files are in ASCII format.

For each hour from the selected start date to the selected end date, four 15-minute average values of temperature and humidity and twelve 5-minute average values of each wind and AQ parameter are averaged. This reduces the number of values needing storage. (The file lengths of the *.WX and the *.HR files appear in Table VI-2.)

WXSUM first checks to see that the start date is before the end date. Then the program finds the start date and computes hourly averages. Tables are made and sent to their selected destinations. After the last hour of the last day, the program closes all open files and stops. The *.HLY and *.HR files should appear in the \WXOBS subdirectory.

2.4.3 The AQ hourly translation program (AQHRS)

Because the WXSUM program described above does not change AQ voltage outputs to direct readings of concentration, it is necessary to run another program before the AQ values on the *.HR files can be interpreted with any validity.

The AQHRS program creates hourly averages of AQ concentrations by reading the raw *.WX AQ voltages data, multiplying them by 100 to obtain parts per billion (ppb), and eliminating ZERO and SPAN values gathered during the daily CAL checks. The data are processed minimally and are intended only for immediate use by on-site personnel.

The AQHRS program reads raw 5-minute average AQ and 15-minute average CAL voltage data from the *.WX file. The CAL channel (calibration channel 2) for each station is checked to see if it indicates a calibration. Data gathered during CAL periods are replaced with null data characters (-9999.), while all remaining data are averaged for each one-hour period through the ending time of the last *.WX or *.HR file (whichever comes first). The program also translates the hourly average voltages to ppb by multiplying the values by 100.

Because data are read in binary form off the *.WX file and written onto the *.HR file, the possibility of duplicate runs and double conversions is eliminated.

2.4.4 The hourly data tabulation program (AQHTAB)

This program displays hourly average AQ values, including the daily and monthly maximum, second maximum, and mean (average) concentrations, for any or all monitored pollutants at any or all AQ stations for a given month. (The second maximum is simply the second highest hourly concentration for the 24-hour period (midnight to midnight) or for the hour of the day involved.)

Output consists of a table or a set of 16 tables, saved as files on hard disk under the filename AQHR.TAB (for single tables) or AQ[monyr].TAB (for a set of up to 16 tables), where "mon" is the 3-letter abbreviation for the month and "yr" is the last two numbers of the year. Printout of these tables can be done directly with a PRINT program (Section 3.3.5) or by using PE2 (Section 3.4). Each table displays all the hourly concentrations in parts per billion by volume (ppbv) for a given pollutant at a given station for the month by time of day (across the page) and day of month (down the page). Table VI-4 is an example of such a table. Data are read from the *.HR file and are valid only if AQHRS has been run for the month involved. If AQHRS has not been run, the values shown will be in raw voltages. Most of these will be about one one-hundredth of the observed ambient concentrations in ppbv (or of the CAL ZERO or SPAN values if in the CAL mode).

2.4.5 The data recovery analysis program (RECOV)

A *.WX file can be thought of as a table with 96 rows (or lines) corresponding to the 96 15-minute periods in a day and one column for each instrument in the field. Because of data-logger failure, transmission problems, or instrument failure (usually a rare occurrence), a *.WX file may not be complete. By running RECOV, the operator may keep track of the data recovered by the CHAWS system and stored in *.WX files.

The RECOV program reads the *.WX files and generates daily tables showing the status of each 15-minute period for each instrument. Table VI-5 is a sample of such a table. The program interchanges the rows and columns, so the tables contain 96 columns (one for each 15-minute period) and a row for each instrument (including all the stations). It writes the letter "M" if data are missing and the ASCII 250 symbol "-" if they are present. It writes these tables to a file "RECOV.OUT".

The date, filename, and percentage of data recovered appear at the top of the page, with hour of the day listed across the page at several levels. The index, station number, and channel-type number appear in the left margin, while the station number and instrument-type name appear on the right.

3.0 PROGRAM OPERATION

This section describes the operational aspects of the data-processing software. One subsection is dedicated to each program. Section 3.1 describes the programs that can be run in a real-time mode (including GRAPHIT and WXGRAPH). They are run daily to handle the incoming data. Section 3.2 describes the operation of programs that are run independently of the

H O U R L Y A I R Q U A L I T Y D A T A
at
Tooele A.D. South
Parts per billion of SO2
Station # 1 (East)
Sept 1986

		Hour ending at: 01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG	MAX	2MAX	Day
	1	19	20	19	20	19	20	20	20	20	20	-99	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	1
	2	19	20	20	20	20	20	20	20	19	-99	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	2
D	3	20	20	20	20	20	20	20	20	-99	21	20	20	20	20	21	21	21	20	21	21	21	21	20	21	20	21	21	3
	4	21	20	20	21	21	21	21	-99	21	21	21	21	21	21	20	21	21	21	21	21	21	21	21	21	21	21	21	4
A	5	21	21	21	21	21	21	-99	21	21	21	21	-99	-99	21	21	21	21	21	21	21	21	21	21	21	21	21	21	5
	6	21	21	21	21	21	-99	21	21	21	21	22	22	21	22	22	22	22	22	22	22	22	21	22	22	22	22	22	6
Y	7	21	21	21	22	-99	21	22	22	22	22	22	22	22	22	21	22	22	22	21	22	22	22	22	22	22	22	22	7
	8	22	22	22	-99	22	22	22	22	22	22	22	22	21	22	22	22	21	-99	-99	-99	-99	-99	-99	-99	22	22	22	8
	9	-99	-99	-99	-99	-99	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	9
	10	22	-99	22	22	22	22	22	22	22	23	22	23	22	22	22	22	22	22	22	23	22	22	22	22	22	23	23	10
O	11	-99	23	22	22	22	23	23	22	23	22	23	23	23	22	22	23	23	23	23	23	23	23	23	-99	23	23	23	11
	12	23	23	23	23	23	23	23	23	24	24	23	24	24	24	24	24	24	24	24	23	24	23	-99	24	24	24	24	12
F	13	23	24	24	24	24	24	24	24	24	24	24	23	24	24	24	24	23	24	23	24	24	-99	25	24	24	25	24	13
	14	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	-99	25	24	24	24	25	24	14
	15	24	24	24	24	25	25	24	24	24	24	24	24	24	24	24	24	24	24	24	-99	25	24	24	24	24	25	25	15
	16	24	24	24	24	24	25	24	24	25	25	24	24	24	25	24	24	25	24	-99	25	25	25	25	24	24	25	25	16
M	17	24	25	24	24	25	24	24	24	24	25	25	25	25	25	24	25	25	-99	25	25	25	25	25	25	25	25	25	17
	18	25	25	25	25	25	25	25	24	25	25	25	25	25	24	25	25	-99	25	25	25	25	25	24	25	25	25	25	18
O	19	25	24	24	24	25	24	24	24	25	25	25	25	25	25	25	-99	25	25	25	25	25	25	25	25	25	25	25	19
	20	25	25	25	24	25	24	24	25	24	25	25	25	26	26	-99	28	28	28	28	28	27	28	27	28	26	28	28	20
N	21	27	27	27	27	26	26	26	26	27	27	28	28	29	-99	30	30	31	31	30	30	30	29	28	28	28	31	31	21
	22	28	28	27	27	27	27	27	26	26	26	27	27	-99	27	27	27	26	27	27	27	27	27	26	27	27	28	28	22
T	23	26	26	26	26	26	26	26	26	26	27	27	-99	27	27	26	27	27	27	27	27	27	27	27	27	27	27	27	23
	24	27	26	27	27	26	27	27	27	26	26	-99	27	27	27	27	27	26	27	27	27	27	27	27	27	27	27	27	24
H	25	27	26	27	26	26	26	26	27	27	-99	27	27	27	26	27	27	27	27	27	27	27	27	27	27	27	27	27	25
	26	-99	-99	-99	-99	-99	-99	27	27	-99	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	26
	27	27	27	27	27	27	27	27	-99	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
	28	27	27	27	27	27	27	-99	28	27	27	27	27	27	27	28	27	27	27	27	27	27	27	27	27	27	28	28	28
	29	27	27	28	27	27	-99	28	28	27	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	29
	30	28	28	28	28	-99	28	28	28	28	28	29	28	28	28	28	28	28	29	28	28	29	28	28	28	28	·29	29	30
	AVG	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	25	24	24	25	24	24	24	24			AVG
	MAX	28	28	28	28	27	28	28	28	28	28	29	28	29	28	30	30	31	31	30	30	30	29	28	28		31		MAX
	2ndMAX	28	28	28	27	27	27	28	28	27	28	28	28	28	28	28	28	28	29	28	28	29	28	28	28				2nd
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG	MAX	2MAX	Day
		Hour ending at:																											

Table VI-4. Sample AQHTAB output (AQ[monyr].TAB).

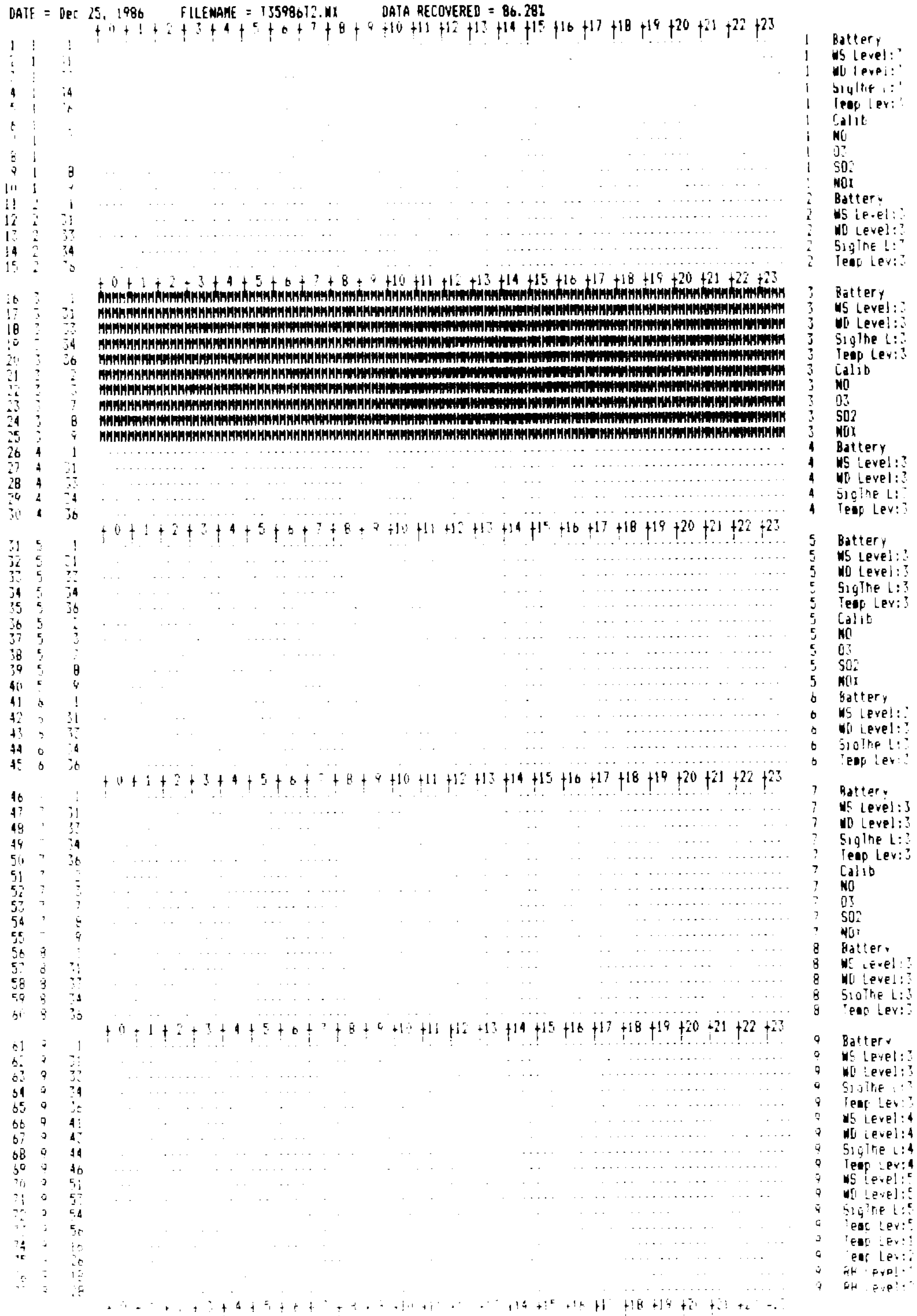

Table VI-5. Sample data-recovery output (RECOV.OUT).

immediate data. Some of this software produces summary files with tables or graphs. These graphs are described in detail in Section 4.

Before running these programs, one should read and understand Section 2.0 (to see what the programs do) as well as this section.

3.1 Continuous data-collection programs

The programs described in this section provide continuous data display and collection for the CHAWS system. Careful and scrupulous examination of the data in the graphic display mode by a trained expert is highly recommended to obtain proper quality control of the data base.

The programs described in this section operate automatically and continuously once started. They are started either at boot-up or at execution of a single command.

3.1.1 BASE.EXE

Data collection at the HANDAR 542 Radio Base Station is started by the CHAWS data-acquisition computer when it is powered up or rebooted. When this happens, the BASE.EXE program should enter the data gathering mode and start scanning (polling) the stations for data. Study Chapter I, Section 2.5 to make sure the screens each appear as they should.

If the computer operates, but polling does not start, it could be that the correct files have not been loaded. The procedures for file loading and troubleshooting appear in Chapter 5.

If BASE.EXE has been stopped for any reason, it may be restarted by rebooting the data-acquisition computer. This is done by striking the <Ctrl>, <Alt>, and <Del> keys on its keyboard simultaneously between data polls. (WARNING--This will erase all volatile memory; see Chapter I, Section 2.3 for details). If data logging does not commence at the next even 15-minute interval, consult the troubleshooting guide, Section 3 in Chapter V.

3.1.2 LOGIT.BAT

This batch file automatically runs the RDHAND2 routines at a specified interval. At least once a day, you should eliminate accumulated time and data errors by rebooting the CHAWS system between data polls by striking <Ctrl>,

<Alt>, and <Del> simultaneously (see Section 2.3 in Chapter I for details). This should begin automatic operation of LOGIT. You may terminate its operation by striking <Ctrl> and <Break> (<Scroll Lock>) simultaneously. (Before doing this, make sure the hard disk doesn't access data for at least several seconds.) You should then get a DOS prompt character set that ends with ">".

If the CHAWS system is turned on, but RDHAND2 is not running, you may start it by typing "logit" after the prompt character and striking <Enter>. (If not in the root or HANDAR directory, type "cd handar" <Enter> before typing "logit".) The only verification that LOGIT is running is the appearance of a flashing cursor in the upper left-hand corner of the screen.

3.1.3 RDHAND2.EXE

This program is run by the batch file LOGIT.BAT for continuous transfer of data to the *.WX files when the CHAWS system is left unattended. It may be started independently of this batch file by typing the DOS command "rdhand2" from the HANDAR directory. No further input is required.

3.1.4 HANDLOG.EXE

This program is not necessary to operate the CHAWS system and is provided as an option. It runs automatically and continuously and creates large daily ASCII files of the RAWDAT data "[jul]_H[yr].DAT" for storage if a backup to the data base is needed. These files are created daily and should be erased at weekly intervals because the files are large and duplicate data that have been already stored in binary format, which is more efficient. Section 3.4 describes PE2, which has procedures for editing and storing these files.

3.1.5 GRAPHIT.BAT

This batch file runs the WXGRAPH program to display current data, as shown in Figure VI-2. Its operation will also replace the functions of LOGIT. Please run it when on-site to keep track of data acquisition.

Before starting GRAPHIT, you must terminate LOGIT by striking <Ctrl> and <Break> (<Scroll Lock>) simultaneously. (Before doing this, make sure the hard disk doesn't access data for at least several seconds.) You should then get a DOS prompt character set that ends with ">". If rebooting has not been done for 12 hours or more, you should eliminate accumulated time and data errors by depressing the <Ctrl>, <Alt>, and <Del> keys simultaneously between data polls (see Chapter I, Section 2.3 for details). This should begin automatic operation of LOGIT. Before starting GRAPHIT, you must now terminate LOGIT as described above.

Now start GRAPHIT by typing its name after the prompt and striking <Enter>. (If not in the root or HANDAR directory, type "cd handar" <Enter> before typing "graphit".) Verify its operation by the appearance of a map on the screen (see the next subsection).

3.1.6 WXGRAPH.EXE

For real-time operation, start this program by typing "graphit" from the root or HANDAR directory (see above). The default initialization file WXGRAPH.INI must have the review mode as FALSE (see 3.1.7).

For the review mode, type "WXGRAPH" from the HANDAR directory after making sure the initialization file shows the review mode as TRUE.

Verify its operation by the appearance of a map on the screen. After drawing the map, the program draws trajectories and time series (see Section 2.3.6 and Figure VI-2).

3.1.7 WXGRAPH.INI

The purpose of the WXGRAPH initialization file WXGRAPH.INI is to tell the WXGRAPH program what parameters, time scales, and colors to use in the graphic display.

To examine this file, get into the HANDAR directory (if not already there) by typing "cd handar" <Enter>. Now type "PE2 wxgraph.ini". The file should then appear on the screen. If not, see Section 3.4 (PE2). Edit it using PE2, and you must SAVE or FILE it by typing "save wxgraph.ini notabs" on the PE2 command line (unless the second line of your PE2.PRO file says "s blankcompress off", per subsection 3.4.6). If you don't do this, strange things may happen to this file and the WXGRAPH program. It won't know what it is reading, and many errors will occur. <F2> or <F3> may be used to get "SAVE" or "FILE" on the command line, respectively.

According to current needs, you may change various numbers and labels in order to change trajectory locations, starting times, and colors, as well as many parameters associated with the time-series graphs. Table VI-6 shows an abbreviated version of the file with one-line descriptions in the right-hand columns.

It is important to remember that WXGRAPH is expecting these parameters in a certain order. If a line of WXGRAPH.INI is moved, deleted, or added, WXGRAPH may not be able to read the data properly. When more than one number is required on the same line, the numbers must be separated with commas. Labels must be delimited at both ends with single quotes ('), and the length of each label is limited to 8 characters for the map file and 6 for the title. Four groups of items can be changed: miscellaneous, map, time series, and trajectories. We now describe each of these groups.

3.1.7.1 Miscellaneous. The first 9 lines of WXGRAPH.INI contain miscellaneous information. The first line is a remark line and is not read by the program; use it for any information you want to display in the file itself such as site name, time the run was made, etc. The next line determines the mode of display (review or real time). The question is posed "Review Mode?". The answer (which appears before the cycle-time value and the question itself) is ".TRUE." for review mode or ".FALSE." for real-time mode. (For operation of GRAPHIT, "FALSE" must be specified. If review mode is selected, the WXGRAPH program should be started directly.) The time per cycle (cycle time) must also be specified. The cycle time is the amount of time added to the reference time when drawing the next WXGRAPH screen, which is not automatic when in review mode.

The next line determines the horizontal instrument level used for data when a trajectory path is drawn. The number of time-series graphs should always be four. The next four lines determine the position of the times-series axis inside the graph windows. There should be no reason to change these numbers. The border between the time-series graphs and the map is specified next as a decimal number from 0 (far left) to 1 (far right).

The period end-time at the far right of any series graph is also displayed on the bottom left of the screen, below the map. The number 0.60 shown in Table VI-6 will result in graphs being drawn just to the right of the center of the screen.

Table VI-6. Initializing file for WXGRAPH (WXGRAPH.INI).

Actual WXGRAPH.INI line	Short Description (see text for details)
WXGRAPH.INI- -INITIALIZING FILE (E2)	Remark Line; no effect on WXGRAPH
.FALSE., 120, Review Mode?	FALSE=real-time;TRUE=review;120=cycl time
5, Use This Horizontal Level	Level for wind trajectory data
4, Number of time series	Number of graphic param.plots (ALWAYS 4)
0.2, << XLftMarg	
.05, << XRgtMarg	Position of time-series axes
.01, << YTopMarg	in boxes (no reason to change)
.14, << YBotMarg	
.60, << Border between map and series	0=far left;1=far right;.60=right of ctr.
0, Color of map background	0= black, 1= blue, etc. (see Table VI-7)
385.,<< X1	Right edge of map UTM coord., kilometers
355.,<< Y1	Bottom edge of map UTM coordinate, km.
364.,<< Y2	Top edge of map UTM coordinate, km.
'EL',<< MAPFILE	Map filename (see Table VI-8)
*******************************	
1, Time series # 1	Top plot (highest on page)
'Direc', <<Title	Direc = wind direction; MAX 6 char.
3, Background color	3 = Cyan (see Table VI-7)
120, Time covered (min)	120 = 2 hours (recommended); 30-360 OK
45., Y-Low	Bottom of WD scale, deg (leave 45 = NE)
405., Y-High	Top of wind dir scale, degrees (405 = NE)
45., Y-Tic	Tic mark interval (MUST be 45 degrees)
5, Number of traces	5=5 parameter traces plotted (MAX of 5)
2,53, 9, 1	
4,53,11, 1	Sta.#, Ch.# (53=WD), Color (Tab.VI-7),
5,53,12, 1	Data Point Mark (Table VI-10)
6,53,13, 1	
-2, 3,15,-4	Sitewide Avg(Tb VI-9),#Avg's, color, mark
*******************************	
2, Time series # 2	Next plot (2nd highest on page)
'Speed', Title >> Speed	Speed=wind speed; max of 6 char.
3, Background color >> 3	3 = Cyan (see Table VI-7)
120, Time covered (min) >> 120	120 min (2 hr) recom.; 30-360 min OK
0., Y-Low	Bottom of wind speed scale; keep 0 mps
-9999., Y-High	-9999.=Set top of WS scale abv max. value
-1.0, Y-Tic	Tic mark interval (-1 with any vrbl scl)
5, Number of traces	Must match no. of lines below (up to 5)
2,51, 9, 1	
4,51,11, 1	Sta.#, Ch.# (51=WS), Color (Tab.VI-7),
5,51,12, 1	Data Point Mark (Table VI-10)
6,51,13, 1	
-1, 3,15,-4	Sitewide Avg(Tb VI-9),#Avg's, color, mark
*******************************	

Table VI-6. Initializing file for WXGRAPH (WXGRAPH.INI) - Cont'd.

Actual WXGRAPH.INI line	Short Description (see text for details)
3, Time series #3	Third plot on page
'Temp', Title	Temp = temperature (Ch #56 for level 5)
-9999., Y-Low	-9999.= Set top of Temp. to incl. min.
5, Number of traces	(For these 6 lines, see above)
*******************************	
4, Time series #4	Fourth plot on page
'SigThe', Title	SigThe=sigma theta (Ch #54 for level 5)
80., Y-High	80 | =maximum value; Don't change
10., Y-Tic	10 | =Tic interval; Don't change
*******************************	
1, Step every (min)	Keep as 1 min betw. trajectory symbols
1, Number of trajec	1 traj drawn each loc.(0-10;2-3 recom.)
60,11	Traj. Time (20,30,40,60 min OK), Color
2, Number of locations	Start trajectories-2 places (up to 3 OK)
390.7, 361.2	
388.0, 359.0	Start Locations in UTM coord., km.
388.0, 362.0	(#lines | No. of locations above)
*******************************	

3.1.7.2 Map. The map background color (see Table VI-7) must be chosen to contrast with the map colors. The next three lines represent the map boundaries (X1, Y1, and Y2), which can be changed using PE2. X1 is the left edge, Y1 is the bottom, and Y2 is the top. X2 is the right edge and is calculated by WXGRAPH to avoid distortion of the map.

Table VI-7. List of color index numbers.

Index	Color	Index	Color
0	Black	8	Gray
1	Blue	9	Light blue
2	Green	10	Light green
3	Cyan	11	Light cyan
4	Red	12	Light red
5	Magenta	13	Light magenta
6	Brown	14	Yellow
7	White	15	High-intensity white

The units used on the map are UTM coordinates with units expressed in kilometers. The map filename is presented as a quoted string. See Table VI-8 for a list of the CHAWS sites and corresponding map file names. The map files should be in the MAPS subdirectory.

3.1.7.3 Time series. You can edit the WXGRAPH.INI file, line by line (see Table VI-6), using PE2 (Section 3.4) for the desired time-series graphs. The parameters for these plots are specified on lines between the asterisk lines (***********). Each time-series graph corresponds to an information package in the initialization file, starting with the time-series number. The time-series title describes the parameter to be plotted. It appears on the second line inside quotes and must not be greater than six characters. The background color is next (see Table VI-7 for colors). The axes and title are

Table VI-8. Map filenames.

Site	Use map file
Tooele	LRGRSCL
Edgewood	EL
Pine Bluff	PINEB
Lexington	LX

drawn with black (except if black is the background color, in which case they appear green). The amount of past data drawn can be changed in the next line. Two hours (120 min) seems to be a good balance between amount of data shown and the time it takes to draw a graph.

For most parameters, the vertical axis limits Y-Low, Y-High, and Y-Tic should not be changed. However, certain parameters that vary (e.g., wind speed) can have the bottom fixed at zero and the top programmed to vary with the maximum wind speed. In such cases, enter a Y-High of -9999 for the top or a Y-Low of the same value for the bottom.

The tick mark interval, Y-Tic (for the notches on the scale), can also be adjusted for wind speed but should stay the same for wind direction and most other parameters.

When one or both of the axis limits is allowed to vary with the data, the tick interval (Y-Tic) should be set to -1. This tells the program that it can also change the tick interval but that the smallest it should be is 1 (the absolute value of Y-Tic).

The tick interval should always be 45 on a wind-direction plot. WXGRAPH adds 360 to wind directions less than 45 so that the top and bottom edges of the graph are not exactly north. (This greatly reduces the amount of jumping across the scale that often would be done with borders at north or east because of the frequent winds from these directions at most sites.)

The "Number of traces" line in the WXGRAPH.INI file contains information the program uses to draw actual graphs of time-series traces (usually on the right side of the screen). As can be seen in Table VI-6, there can be up to 5 traces per graph with one line below to describe each trace.

Each of these lines should contain 4 numbers for each trace: 1, station number; 2, channel number; 3, color; and 4, data-point style (appearance of data marks such as stars, crosses, etc.). A negative station number is used to depict a site-wide average. It is followed by the number of values averaged in each 15-minute data period, rather than by channel number. (Because data from the anemometers are in 5-minute averages, 3 is used in Time Series No. 1 (Table VI-6) because there are three 5-minute averages in 15 minutes.) Table VI-9 is a list of negative station numbers and the corresponding parameter being averaged.

Table VI-9. Negative station numbers for site-wide averages.

Station No.	Parameter
-1	Wind speed
-2	Wind direction
-3	Sigma theta
-4	Temperature
-5	Relative humidity

The channel number referred to above is the standard CHAWS channel number (e.g., 31 is wind speed at level 3, 56 is temperature at level 5). The trace color should contrast with the time-series graph background color. Traces from the same station should have the same color for each plot. See Table VI-7 for a list of colors. The data-marker types appear in Table VI-10.

3.1.7.4 Trajectories - Near the bottom of the initializing file are a few lines that give the operator the ability to change the way the trajectories are drawn. The first line contains the time-step number between data markers. This should always be 1 (1 minute).

The next line sets the number of trajectories to be drawn at all locations. This number must be between 0 and 10, although drawing more than four trajectories is both time consuming and covers too much of the map. Two or three trajectories at all start locations give the best results.

Table VI-10. Data-line marker types.

Value	Trace drawn with
-4	Crosses
-3	Stars
-2	Rectangles
-1	Circles
1	Dotted line
2	Dashed line
3	Solid line

The next line(s) describes the color and length of time of the trajectory. The quantity of these lines of color information must be equal to the number of trajectories from the previous line. Typical time lengths are 20, 40, and 60 minutes for three trajectories and 30 and 60 minutes for two. Refer to Table VI-7 for the numeric values of the 16 colors.

The number of locations to start a trajectory and a list of those locations appear at the bottom of the initializing file. WXGRAPH uses UTM coordinates (E-W then N-S) with units of kilometers. The number of coordinate pairs should be equal to or greater than the number of locations. Although WXGRAPH can accept 0 to 10 locations, 3 locations that encircle the site give the best results.

3.2 Data examination and summary programs

The purpose of the software described in this section is to study, reduce, and archive the data base. As with Section 3.1, careful examination by a trained expert of the tables discussed below is highly recommended for quality-control purposes.

This software operates independently of the CHAWS data-acquisition system. Because the host computer and Slave 2 terminals are presumed to be involved with data acquisition, these programs should be run from the Slave 1 keyboard (unlike those discussed above).

Before running any of the programs discussed below, check the input file list given in Table VI-1 to be sure all the input files are in the correct subdirectories. In most cases, the input files will be in the HANDAR subdirectory and the output files will be written to the WXOBS subdirectory.

When answering interactive user-input questions on the screen, you may use "Y" or "y" for "yes" and "N" or "n" for "no".

Many of these programs produce tables showing data for 5-, 15- or 60-minute periods over a day or month. Detailed use of these tables is discussed in Section 4.2.

3.2.1 WXLIST.EXE

WXLIST is to be run from the HANDAR subdirectory in order to provide readily available examination of the short-term *.WX file data. Before running it, make sure that the following files are in HANDAR: WXLIST.EXE, WXLIST.HLP, WXLIST.PRE, WXLIST.INI, WXCONF.CNF, and WXCD.FIL. Also be sure that WXCD.FIL has 20 lines by viewing in PE2 (see PE2 instructions in Section 3.4). If not, add lines until there is a total of 20. Line 20 should look like this: "20_WXLIST___________C:\HANDAR". All the *.WX files to be read must be in the WXOBS subdirectory. WXLIST will work at all the sites. The WXLIST preset file (WXLIST.PRE, subsection 3.2.1.4) is site specific and user defined.

To run WXLIST, type "wxlist <Enter>". You should now see a user input screen display (Figure VI-3). Changeable parameters are highlighted in green, and the cursor parameter is highlighted in white. Changeable parameters consist of the following:

Start date and time	Stop date and time
Amount of time (hrs and mins)	Number of channels
Station number	Channel number and name
Output destination (screen, file, and/or printer)	

3.2.1.1 Changing input parameters. To move the cursor from one parameter to another, use the tab (-->) and back tab (<shift> -->) key. Change parameters by using the Up and Down Arrow keys and the Page Up ("<PgUp>") and Page Down ("<PgDn>") keys on the right side of the keyboard. In general, the <PgUp> and <PgDn> keys increment the selected parameter by a larger amount. The increments by which the values are changed appear in Table VI-11.

```
                    CHAWS Data Listing Program

        Date             Time    Record        Filename        Exist?
 Start
 Stop
 Amount of Time:         hrs     mins      Number of Channels:

 Station    Channel #  Channel Name      Station    Channel #  Channel Name
1                                     6
2                                     7
3                                     8
4                                     9
5                                    10

Output: Screen?      File?      Printer?

PRESS KEY             OPERATION
Up Arrow, PgUp     => Increase Value                          f1 = HELP!!!!
Down Arrow, PgDn   => Decrease Value
Tab Right or Left  => Move to Next Parameter
Q                  => Quit
R                  => Run with Current Values
```

Figure VI-3. WXLIST user-input screen display.

Table VI-11: WXLIST INPUT SCREEN DISPLAY CHANGES

	Channel Date (days)	Time (mins)	Station #Channels (n)
Up Arrow (8) = Increase value by	+1	+15	+1
Down Arrow (2) = Decrease value by	-1	-15	-1
<PgUp> (9) = Increase value by	+7	+60	+1
<PgDn> (3) = Decrease value by	-7	-60	-1

Correct, pre-defined keystrokes respond with a high-pitched "beep"; undefined keystrokes respond with a low pitched "blah".

The default settings for the WXLIST program are as follows:

Start date/time -- current date/time less one hour
Stop date/time -- current date/time
Number of channels -- one
Sta/chan combination -- usually Station 1/Channel 1 (Battery)
Output -- to screen, to file "WXLIST.OUT", but not to printer

As start date/time and stop date/time are changed, the amount of time run (stop time minus start time) changes accordingly. Although this amount can be negative while searching through the dates/times for the right combination, WXLIST will create the error message "Check Start/End Dates" or "Check Start/End Times" in the upper left-hand corner of the screen (above the start date) if you try to run it with a negative amount of time (start date and end dates reversed). This message will also prompt you as to where to look for the error. If you change the amount of time directly by using the arrow keys, the start date/time will remain fixed but the stop date/time will change to reflect this change.

The number of channels can range from 1 to 10. Pressing the down arrow from 1 will give you 10; pressing the up arrow from 10 will give you 1. As the number of channels changes, the station/channel number spaces below are filled or deleted with default values or with the most recent values. (For screen and printer output, it is recommended that you use only up to eight channels to keep the tables clear. Otherwise, the numbers will wrap -- i.e., they will go to the next line without printing under the right headings.)

Now is the time to use the arrow keys to select station and channel numbers. Move the cursor to highlight a station space. Select the desired station by using arrow keys. Now move to highlight the corresponding channel-number space (-->). Select a channel number using the arrow keys. You will be able to toggle only through those channel numbers installed at the given station.

If you then move back to the station space (<--) and change the station to one that doesn't have that channel, the station and channel number will blink until one of them is corrected to a valid station or channel number.

Data can be sent to any combination of up to three output devices: the screen, a file (WXLIST.OUT), or the printer. Move highlight to each and toggle through Y(es)/N(o) with the Up or Down Arrow keys. WXLIST.OUT can be found in the HANDAR subdirectory after termination of the program. If output is requested to go to the printer, make sure that the printer is at the top of the page and on line before striking "R" to run the listing portion of the program.

3.2.1.2 Other keystrokes. Press <F1> to view the help screen. Press <F2> to view/edit the preset file (WXLIST.PRE) (discussed below). Press <F3> to see a directory of available *.WX files. Press "D" to reset the program to default settings. Press "Q" to quit. (R, D and Q may be upper or lower case.)

3.2.1.3 Running the program. Press "R" to have the computer run the program for the selected combination. All error messages appear in the upper left-hand corner of the screen, above the start date/time. Figure VI-3 shows the user-input screen without any error messages.

A few quality checks are performed before the program will list the requested data. It first checks to see if the amount of time is greater than zero (i.e., that the start date/time is less than the end date/time). If it is not, a message to check them will appear.

It then checks for the existence of the start and end files. If one or both do not exist, "Check Start/End Dates - File Not Found" is printed on the screen. If a file is missing between the start and end files, the data will appear as null values (-9999. or -99.) in the output. A message will be displayed on the screen reflecting this occurrence.

Finally, WXLIST checks to make sure all station/channel combinations are viable and that none are blinking. If there are combinations that do not exist, "Check Station(s)/Channel(s)" is printed to the screen.

The program will return to the input screen after it has finished listing the requested data. Parameters can then be changed and the program run again without termination. If data are sent to the file WXLIST.OUT, data from each successive run will be appended to the previous run's output until the program is terminated.

If you decide to terminate the program but want to save the output file, change its name in DOS or in PE2 with the COPY or the RENAME command (see subsection 3.3.6 or type "RENAME WXLIST.OUT [new path, filename]" on the PE2 command line). Note: the next time WXLIST is run, the old output file WXLIST.OUT from the previous run will be erased. Messages created by WXLIST that are helpful for debugging purposes are found in the file WXLIST.XXX in the HANDAR subdirectory. This file is also erased when the program is rerun.

3.2.1.4 WXLIST presets and the preset file (WXLIST.PRE). An option that makes selecting common station/channel combinations easier is the use of 10 preset combinations. By pressing <alt-1> through <alt-0>, you can set up a specific station/channel configuration for the program to list.

The presets may be changed by editing the preset file WXLIST[s].PRE, where [s] is a site indicator letter (T for Tooele, E for Edgewood, L for Lexington, and P for Pine Bluff). To edit this file, type PE2 WXLIST[s].PRE from the HANDAR subdirectory. Important: WXLIST[s].PRE needs to be copied to the default preset filename of WXLIST.PRE using the DOS COPY command (see subsection 3.3.6) in order for the program to read the most recent changes before it is run.

You can also change the default preset file WXLIST.PRE from within the program by striking <F2>. This will take you into PE2 to view or edit this file. If you change anything here while running the program, you should copy or rename WXLIST.PRE back to the site-specific file WXLIST[s].PRE after terminating the program to avoid losing those changes.

The preset file consists of a title (WXLIST PRESET FILE), followed by the preset definitions. For each preset, the keystroke name is preceded by its ASCII equivalent, e.g., 120 is the ASCII equivalent of <alt-1>. The next line gives the number of channels (0-10). The next lines must be equal in number to the number of channels. They consist of station/channel combinations -- one per line, separated by commas. For example, if <alt-1> was for Station 1, Channel 1 (Battery), the preset definition would look like this:

120,	<alt-1>
1,	Number of Channels
1, 1,	Station, Channel

To disable a preset, change the number of channels to zero and delete the lines that follow until the beginning of the next preset definition. If you try to use this preset later, a message "Preset not defined" will appear on the screen above the start date. Exit PE2 in the usual manner to return to the input screen.

3.2.1.5 WXLIST initialization file (WXLIST.INI). The initialization file provides the program with information on screen colors, cursor position, and screen design. Only the screen colors should be changed. Cursor position and screen design should remain as they are.

The input screen colors can be changed by changing the first few lines in the WXLIST.INI file. Four color parameters may be changed: the base text (now blue), the changeable parameter highlight (now green), the current-parameter highlight (now white), and the wrong station/channel indicator (now blinking green). The brightness and color parameters are listed in pairs separated by commas. Table VI-12 shows how they appear in the WXLIST.INI file.

The first number sets color brightness -- 0 for dull, 1 for bright. The bright form of most colors shows up best on the black background. The 5 in color parameter #4 sets up the blinking. Changing these specifications is not recommended.

The second number in each pair sets the color of the text according to the codes given in Table VI-13.

Save the WXLIST.INI file only with NOTABS as follows. When finished editing, press <F3> then type "WXLIST.INI NOTABS" after the word "FILE" and press <return>. If this is not done, the screen will appear in disarray when you try to run the program (unless the second line of your PE2.PRO file says "s blankcompress off", per subsection 3.4.6). The input screen (Figure VI-3)

Table VI-12. WXLIST screen display color parameters.

Colors	Description
1, 34	Base text
1, 32	Lowlighted
1, 37	Highlighted
5, 32	Wrong channel for station (blinking)

Table VI-13. WXLIST screen display colors.

Code	Color	Code	Color
30	Black	34	Blue
31	Red	35	Magenta
32	Green	36	Cyan
33	Yellow	37	White

is also located within the WXLIST.INI file, and the program expects to read it in a certain format.

3.2.2 WXSUM.EXE

To create the *.HR files containing hourly averages of all parameters for each day, it is necessary to run the WXSUM program. (For AQ values, it is also necessary to run AQHRS.)

Because of the specific characteristics of each CHAWS site, WXSUM is unique at each site and is given a unique name, as shown in the following list:

Tooele	WXSUMT	Edgewood	WXSUME
Pine Bluff	WXSUMP	Lexington	WXSUML

The operation of all the WXSUM programs is identical. The only difference between the programs is the form of the hourly average data tables.

Before running WXSUM, you should indicate, by selecting a start and end date, which data period is to be averaged. Look into the WXOBS subdirectory (see 3.3.2 for "DIR" instructions) to find the *.WX files that correspond to that period. If the *.WX files are not all there, copy them from the archive floppies (see 3.3.6 for "COPY" instructions). When all *.WX files for the desired period are in the WXOBS subdirectory, make sure enough room exists for the files to be created by the WXSUM program. (The size of these files is shown in Table VI-2.) If you don't think enough room exists, copy the excess *.WX files to archive floppies or select a shorter period to run WXSUM.

To run WXSUM, make the default device C and the default subdirectory HANDAR (see 3.3.2 for details). Now, start WXSUM from the Slave 1 keyboard by entering "wxsum" plus the site suffix, as above. Below is an example for Tooele:

```
         c: <Enter>
cd\handar <Enter>
   wxsumt <Enter>
```

After the last command, wait for the program to display a 'user-interface' screen. As shown in Figure VI-4, the screen has places to change the input parameters for "System Configuration", "Start Date", "End Date", and "Send Data to:". The use of the TAB, Up and Down arrow, and <PgUp> and <PgDn> keys to change parameters is the same as in 3.2.1.1.

Use the Tab Right key to move the highlight to the Start Date. The Julian date appears to the right of the calendar date. Change this date as required by pressing the keys discussed above.

Next is the 'File Exist?' column, which simply answers the question as to whether or not the file for the specified date exists. As you change the date, the program will automatically change the answer to the question and the filename to the right. 'Y' means yes, it exists in the WXOBS subdirectory and 'N' means no, it does not exist in that directory. Check other directories or add the file from the archive floppies.

```
                    Weather Summary
         Hourly Averages of Remote Weather Stations

System Configuration
                                 File
                                 Exists?
Start Date -

End Date   -

Send Data to:
         Screen?         Y
         Printer?        N                 f1 = HELP!!!
         File *.HLY?     Y
         File *.HR ?     Y

         PRESS KEY          OPERATION
         Tab Right or Left |> Move to Next Parameter
         Up Arrow, PgUp    |> Increase Value
         Down Arrow, PgDn  |> Decrease Value
```

Figure VI-4. WXSUM user-input screen display.

Just before you run the program, decide where to direct the output. Because screen output takes much longer to run, it is not recommended unless you need to check hourly averages as they are being computed. Because the printer is a very slow device, printed output of the tables is also not suggested. It is much faster to save the tables in *.HLY files to be printed at a later time or reviewed in an editor such as PE2.

The hourly averages are saved in binary form in "T[julyrss].HR" files, where jul is the Julian date, yr is the year, and ss is the site identifier, which is T2 for Tooele, P2 for Pine Bluff, L2 for Lexington, and E2 for Edgewood. WXSUM puts the *.HLY and *.HR files in the WXOBS subdirectory. Select an output mode by pressing the up or down arrow keys until a 'Y' or 'N' appears.

For additional help, press the following function keys:

F1 - Write a help file WXSUM.HLP

F3 - Write a listing of the *.WX files

F4 - Write a listing of the *.HLY files

F5 - Write a listing of the *.HR files

When you are satisfied with the start and end dates and the output modes, press R to run the program. WXSUM first checks to see that the start date is before or the same as the end date. If it is not, the operator is warned by a message found at the top of screen; otherwise, the program continues to run. It finds the start date, computes hourly averages, makes tables, and sends them to their selected destinations. After the last hour of the last day, the program closes all open files and stops. The *.HLY and *.HR files should appear in the WXOBS subdirectory.

The *.HLY tables list the hourly average values of wind speed ("WSpd") and direction ("Wdir"), wind direction standard deviation, (also called sigma theta or "SigThe"), temperature (Temp"), relative humidity ("RHum"), and battery voltage ("Batt") for all the stations at the site. Each level is listed for the multi-level towers. The "NOTES" at the bottom explain other symbols besides numbers that may appear in the columns of the table. For instance, "----" means there are no instruments at this location.

The values U-STAR and T-STAR represent logarithmic vertical profiles of wind and temperature. They are important to atmospheric stability. T-STAR has been incorporated into the automatic input to D2PC.

3.2.3 The AQ hourly translation program (AQHRS)

Although WXSUM may have been run to give hourly averaged meteorological data for a given period, the AQ values need to be calculated from the averaged raw voltages, and the calibration data need to be removed before they can be used. For this purpose, it is necessary to run AQHRS, which writes translated AQ data to the *.HR files (see Table VI-1). AQHTAB (see below) then reads hourly data from these files to generate tables.

The AQHRS program asks you to input the year and starting Julian date for which the program is to be run (see Appendix I-C for Julian date vs calendar date). It will then look for the *.WX file for the first day requested followed by succeeding days until the current day, at which time it terminates with the message, "NO MORE T[JULYR]T2.WX FILES THRU CURRENT TIME; PROG TER".

If one of the *.WX files does not exist, it simply prints a message onto the screen "NO FILE FOR JULIAN DATE = " and continues with the next day. This message and other operational messages are all written to the output file "AQHRS.XXX", which may be reviewed by using an editor program such as PE2.

3.2.4 The AQ hourly tabulation program (AQHTAB) (Figure VI-5)

To start this program, type "aqhtab" <Enter>. Then after it responds "ENTER YEAR, MONTH (0,0 TO STOP)", enter the year and the numerical value of the month for which the program is to be run. It then asks whether or not to "PRINT ALL TABLES?", to which you should type "y" for yes or "n" for no, followed by <Enter>. Note: the program does not print output tables directly. Instead, it writes them to an output file. A sample output table appears as Table VI-4.

If you answer "y" to the above question, AQ tables for all stations and pollutants are written to the file AQ[monyr].TAB, where "mon" is the 3-letter abbreviation for the month and "yr" is the last two digits of the year. For the "n" answer, you are asked to "ENTER AQ STATION NUMBER ([station list])", and then to "ENTER CHANNEL NUMBER (3, 7, 8, or 9)" for required pollutants. The table requested will then be written to the output file "AQHR.TAB".

After AQHTAB has run for the month discussed above, it will again ask you to "ENTER YEAR, MONTH (0,0 to stop)". If you want to run AQHTAB for another year and/or month, enter them as before. If you answer "n" to the "PRINT ALL TABLES?" question on two or more adjacent runs, the output tables will be listed in order on the currently active "AQHR.TAB" file. Only one such file can exist at once, however, so if you terminate the program and run it again, the existing file with that name will be erased. Any time you answer the YEAR, MONTH question with "0,0", you will stop the program and return to DOS.

The "([station list])" given after "ENTER AQ STATION NUMBER" will vary from one site to another. It is found on the initialization file AQHTAB.INI (see next subsection). The channel numbers will not vary between stations or sites. They are 3 for NO (nitrogen oxide), 7 for O_3 (ozone), 8 for SO_2 (sulfur dioxide), and 9 for NO_x (all nitrogen oxides). The NO_2 concentrations can be calculated by subtracting the NO from the NO_x.

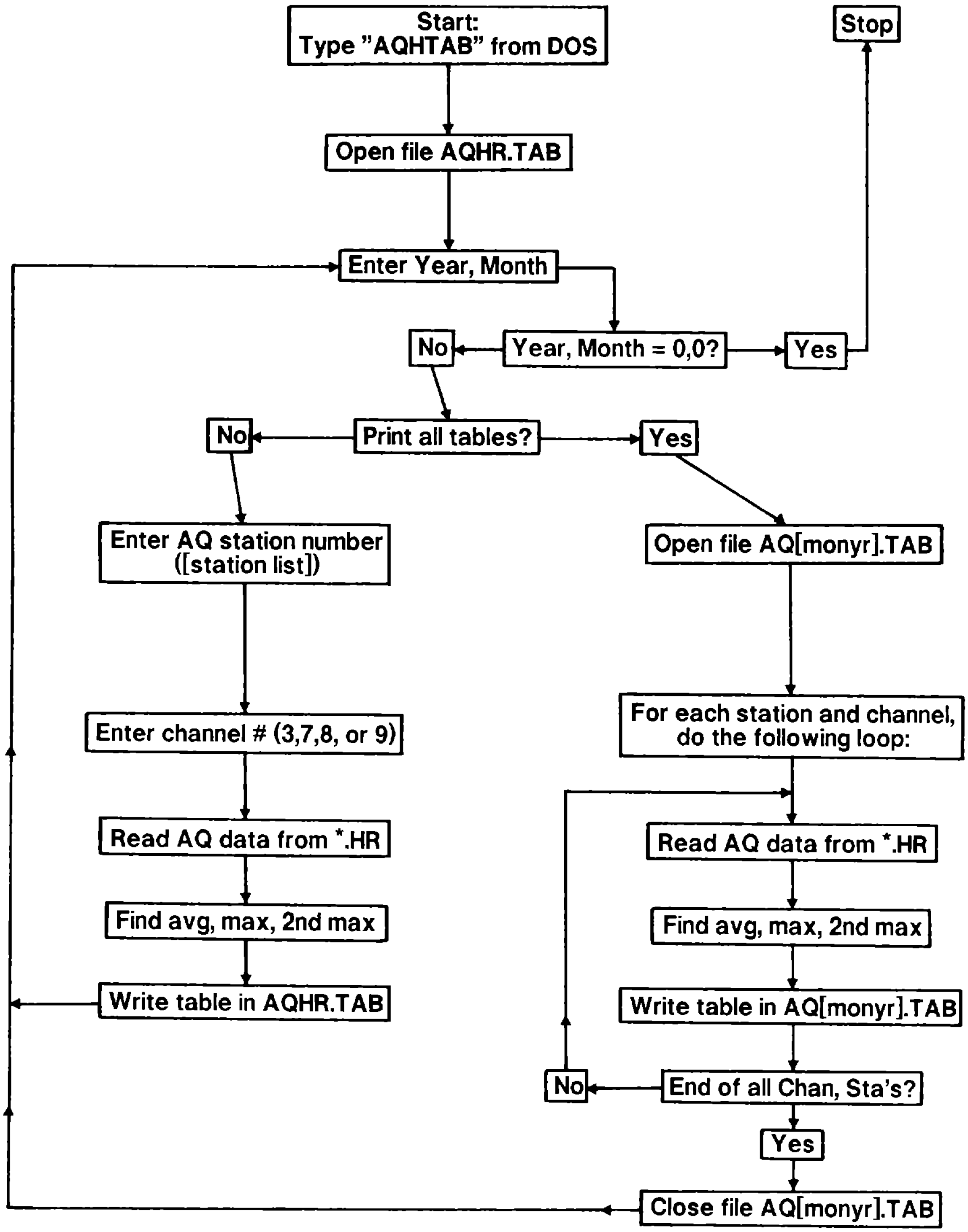

Figure VI-5. AQHTAB user-input flow chart.

Numbers in the output tables are rounded to the nearest whole part per billion (ppb). However, "<1" is substituted for "0" to avoid the illusion of a zero concentration, which will not occur in nature. If an actual zero appears in a table, the analyzer is indicating at least slightly on the low side. Even concentrations of 0.1 ppb are converted to "<1", not zero.

If there is a problem with any analyzer, and it generates false negative values, these will not appear as negative in these tables but as zeros. The values from this analyzer should be checked with an on-site printer per Section 4.2.

3.2.5 The AQHTAB initialization file (AQHTAB.INI)

The purpose of the AQHTAB initialization file AQHTAB.INI is to provide site-specific information to the AQHTAB program. It should not need editing or changing because the AQ station configuration is not expected to change.

The first line describes AQHTAB.INI as an initialization file (Table VI-14). The second line gives the screen input request line for AQ station numbers. These numbers may vary from site to site. The lines of asterisks ("***************") are there to separate logical data blocks. The SITELOC line gives the site location to be printed out at the top of the tables. This is followed by the number of AQ stations located at that site. This number should equal the number of lines given in the next logical block below. These lines give the station number followed by the station name (in quotes). Notice that the numbers "Station 1", "Station 2", etc. will not necessarily agree with the station numbers in the first column. They simply list the AQ stations in numerical order. To examine this file, get into the HANDAR directory (if not already there) by typing "cd\handar" <Enter>. Now type "pe2 aqhtab.ini". The file should then appear on the screen.

3.2.6 The data recovery analysis program (RECOV)

The RECOV program is not part of the data train and does not need to be run until it is time to examine the data base for the amount of data recovery. At that time, start it by typing "RECOV" <Enter>. When it asks for the "YR, START DATE, END DATE", type the last two digits of the year followed by the beginning and ending Julian dates, inclusive (see Appendix I-C for Julian date vs calendar date). It creates an output file "RECOV.OUT" that has

Table VI-14. Initializing file for AQHTAB (AQHTAB.INI) (for Tooele Army Depot, South Site).

Actual WXGRAPH.INI line	Short Description
AQHTAB INITIALIZING FILE	File description
'ENTER AQ STATION NUMBER (1, 3, 5, or 7)', INPUT 1	Input command (asked
***	of user).
'Tooele A.D. South', SITELOC	Line to identify site
***	
4, Number of AQ stations	TOTAL no. of AQ sta's
***	
1, 'East' , AQ Station 1 Name	Use any word that will
3, 'South' , AQ Station 2 Name	uniquely identify
5, 'West' , AQ Station 3 Name	which stations you
7, 'North' , AQ Station 4 Name	want. Don't confuse
***	Ch. # with Sta. #.

a page for each day of data recovery. Use PE2 (Section 3.4) to examine this output file. It should only be printed by striking <F7> <Enter> in PE2 (not from DOS) after making some changes described in Section 4.5. A sample output table printout of such a RECOV.OUT file appears as Table VI-5. Its application is described in Sections 4.2 and 4.5.

3.3 Disk Operating System (DOS) primer

This section summarizes the basic DOS commands used to edit and process data and operate programs from the CHAWS system. It contains only reminders and does not replace the DOS manuals. Familiarity with DOS from the DOS manuals and practice with the DOS commands is recommended before running programs on the CHAWS system.

Some DOS commands start programs by simply entering the program name, while others print out, copy, or delete files, create or change directories, etc. When commands (other than PRINT) list filenames preceded by a path (see 3.3.2), the path is not needed if the same subdirectory is already active.

3.3.1 Entering commands

Before entering any DOS commands, you must enter the DOS mode. When booted, the Slave 1 terminal keyboard should enter this mode automatically. If you're already running PE2, enter DOS with <Ctrl>-"d". Type "exit" and press the <Enter> key to return from DOS to PE2.

DOS commands can also be done on the host keyboard, but you must terminate (type "quit" or "exit") or complete most programs before typing the DOS command. Exit LOGIT or GRAPHIT between data polls with <Ctrl>-<Break> (<Scroll lock>).

Confirm that you have entered DOS by looking for the DOS prompt character on the left side of the screen. It may start with a word or two describing the terminal, location, or the program normally run on that terminal (such as "D2PC"). In any case, it will end with the DOS prompt symbol (>). Once you see this symbol, you may enter a DOS command after it on the same line.

You execute most commands with <Enter>. Spacing can be important; you need at least one space between the command and the file acted upon. DOS commands are not case-specific; they may be executed in either upper or lower case. Do not type the brackets "[ ]" shown in the sample commands below. They are only there to designate a specific name to be typed in.

3.3.2 Use of directories

Directories and subdirectories are groups of files listed together on a device. To see which directory you are in, type

"cd" <Enter>.

The computer will respond with a path:

"[dev]:\[directory]\[subdirectory]"

A table of contents for a subdirectory can be obtained by typing

"dir [dev]:\[directory]\[subdirectory]" <Enter>.

(There cannot be a space wherever a backslash ("\") appears.) After this command, the computer will display a table of contents for the specified path (device, directory, and subdirectory) or, if none is specified, the currently active path.

The screen will display a table showing the filenames, element names, number of bytes per file, and the date and time created. At the bottom will be the number of files listed, followed by the number of bytes free (available on disk). This command may be done from the command line of PE2 (without the top and bottom lines of information).

To change directories, use the DOS "CD" command

"cd\[directory]\[subdirectory]" <Enter>

For example, change to the HANDAR directory by typing "cd\HANDAR" <Enter>. There is no need to specify the current directory--only the directory you wish to change to. To call up the root directory, type "cd\".

3.3.3 Starting a program

Programs that don't start automatically when the system is booted may be started from DOS. Simply type the program name following the DOS prompt. If you get a message such as "Bad command or file name", it probably means you misspelled the file or program name or you're in the wrong directory (see 3.3.2). Most CHAWS programs can be run from the root directory, which should eliminate this problem.

3.3.4 Terminating a program

All single-cycle programs (those that operate on only one data set without rerunning for the next time increment) should terminate automatically. Some of these are described in Section 3.2. Programs described in Section 3.1, however, have loops that permit them to continue to run for each succeeding time increment. To terminate either type of program, press <Ctrl> and <Break> (<Scroll Lock>) simultaneously. This may need repeating. Any input-output operation will stop after the device buffer is empty. If all else fails, reboot the system by pressing <Ctrl>, <Alt>, and <Del> simultaneously (WARNING--this will erase all volatile memory).

Most programs should stop running from either procedure. LOGIT will resume operation after a reboot on the host computer.

3.3.5 Printing out a file

Print out a file by typing

"\print \[directory]\[subdirectory]\[filename].[ext]" <Enter>

The computer may prompt you to enter the name of the list device. Simply striking <Enter> again will send the printout to the default device, which should be the primary printer attached to the system. Some programs can be requested to print out data or files from inside the program. This includes PE2, where <F7> is used.

PRINT is not actually a DOS command. It requires a PRINT utilities file, PRINT.COM, that is kept in the root directory, which is why "\" appears before "PRINT" in the above command.

Make sure the printer is turned on, it is on line with the cables connected, and it has plenty of paper. If the printer runs out of paper, no printout is lost. The PRINT command (or the WRITE command in the program) will pause its execution until the paper is refilled.

3.3.6 Copying a file

Use the DOS copy command

"copy [dev1]:[filenam1].[ex1] [dev2]:[filenam2].[ex2]" <Enter>

to copy from device 1 to device 2. Devices can be any letter but must refer to a data-access device such as a hard or floppy disk or a tape drive. The filenames and extension names can (but need not) be changed in the process.

When copying to or from a specific directory or subdirectory, be sure to include the path in front of the filenames given above.

If you want to copy all the possible extensions of a given filename, use "*" in place of the extension. The same applies to filenames, such as all the *.EXE or *.TXT files. This asterisk acts as a "wild card" and copies every name in that location. It substitutes only for filenames or extension, however -- not paths, directories, or subdirectories.

As an example, if you wish to copy all the *.TXT elements on device A to *.DOC elements of the same filename on device B, for instance, type

"copy a:*.txt b:*.doc" <Enter>

The entire contents of a floppy disk drive or directory may be copied with

"copy [dev1]:*.* [dev2]:" <Enter>

3.3.7 Deleting a file

Use the "del" command followed by the filename and extension:

"del \[directory]\[subdirectory]\[filename].[ext]" <Enter>

The filename is deleted from the file-access table, and the data may be written over by other files. If the data have not yet been written over, there are ways of getting them back, but such procedures are beyond the scope of this manual.

3.4 Examination and editing of ASCII files (PE2)

PE2 (Personal Editor, Version 2) is a word-processing and file-editing program that can be used to examine and (when necessary) change ASCII files associated with the CHAWS system. What follows is a general description of the PE2 program and a few commands. For details on these items and many other commands, refer to the "PERSONAL EDITOR II: REFERENCE" manual, which is available at the CHAWS sites.

Before running PE2, see if the files PE2.EXE and PE2.PRO are on the active subdirectory. It is easiest to run PE2 if they are. However, files on any subdirectory may be processed. No directory or subdirectory needs to be specified if the processed file is on the currently active subdirectory. PE2 may be run from any subdirectory if a "\" precedes the PE2 command and PE2.EXE is in the root directory.

3.4.1 Entering PE2

Activate the PE2 program for any filename.ext from DOS by typing

"\pe2 \[directory]\[subdirectory]\[filename].[ext]" <Enter>

The screen will display a work area for text followed by a command line for entering the commands discussed in the following subsections. Enter the work area or return to the command line with the <Esc> key.

A new file may be created in the same manner, specifying the new filename and the path (device, directory, and subdirectory) unless the current path applies. In that case, simply type "\pe2 " followed by the filename desired.

A status line showing the path and filename accessed appears under the command line near the bottom of the screen. If any changes are made to any line in the work area, the status line changes from white to red upon leaving the line of changed text.

A remark line may appear under the status line. If it says "new file", the filename above is new and the work area is blank except for the "- Top of File -" and "- Bottom of File -" markers. This may happen when trying to examine an existing file. If so, the filename has been misspelled or you didn't specify the right device, directory, or subdirectory.

The message "Profile or macro file not found" on the remark line (below the status line) means the PE2.PRO file is not in the active subdirectory. The CHAWS host computer should have it in the root directory, but it also must be in the active subdirectory to avoid the above message display. If the display appears, you may still edit a file, but the PE2.PRO presets cannot be used. If you wish to use the presets, leave PE2 by striking <F3> or <F4>. Now copy PE2.PRO to the active subdirectory (see 3.3.6).

3.4.2 Use of the edit command and function keys

The procedure above allows one to edit a single file. Other files may be edited concurrently by typing

"e \[directory]\[subdirectory]\[filename].[ext]"

on the command line. As above, the directory and subdirectory need not be specified if the file is on the active subdirectory. You may edit as many files as you wish. If the available memory is full, a spill file is created.

The function keys (<F#>) perform many actions for PE2. One can toggle back and forth between files with the <F8> key. Use <F2> to save and <F3> to save and quit a file, each followed by <Enter>. <F4> will quit a file without saving it. <F5> will delete an entire line, and <F6> will delete the part of a line at and to the right of the cursor. Use <F7> <Enter> to print out a file. <F9> and <F10> both add a line. <F9> puts the cursor to the far left, while <F10> puts it below the beginning of the line above. Use the insert mode to add text and the replace mode to write over text. This mode is shown in the lower right-hand corner of the screen, just after the line and column numbers. (NOTE: Before saving a file, be sure you don't need any deleted text from the .UNNAMED file (see 3.4.5).)

The uses of the function keys and other editing features are explained in Figure VI-5. The PE2.HLP file can also be obtained by striking <F1> (if you have it in the currently active subdirectory) and printed out with <F7> <Enter>. It contains slightly more detail than Figure VI-6.

3.4.3 Setting margins

Margin presets are defined at the bottom of the PE2.PRO file. These help the user set the margins quickly by the use of the <Alt>-[number] keys together. The presets currently have the left margin in column 1 and the right margin in the column for 10 times the number of the key. Pressing <Alt>-7, for instance, will give you margins in columns 1 and 70. <Alt>-0 will set them at 1 and 100 (see also subsection 3.4.6).

If custom margins are required, use the SET MARGINS command on the command line. The three numbers following the command designate the left margin, right margin, and paragraph indentation margin, respectively. For a standard text in columns 10-75, with a 5-space paragraph indentation, use

"set margins 10 75 15" <Enter>.

3.4.4 Working with marked text

Text is highlighted so that it can be moved, copied, or deleted. To edit an existing file, mark (highlight) the text as detailed in Figure VI-5. The commands you use the most for editing data files are <Alt>-b (to mark a block) and <Alt>-d (to delete). The block command (<Alt>-b) will mark a rectangle in between the two places where it is used. <Alt>-c is used to mark text along the reading path between its two occurrences. It is best for moving or editing prose. <Alt>-L will mark an entire line, or a series of lines if used twice.

The marking techniques discussed above can be used to delete, print out, or perform other activities upon certain portions of an output file. One <Alt>-b command can be used to mark the upper left corner of the area to be deleted, while the second can be used at the lower right corner, and <Alt>-d

Help Menu 1
Function Keys

```
F1  -- Help Menu
F2  -- Saves current file
F3  -- Saves and quits file
F4  -- Quits current file
F5  -- Erases contents of line
F6  -- Erases to end of line
F7  -- Prints current file
F8  -- Switches active files
F9  -- Inserts line
F10 -- Inserts line and indents
```

Help Menu 2
Exiting Personal Editor II

```
[F3] FILE saves file on disk and
     removes from memory

[F4] QUIT removes file from
     memory without saving

 If you haven't saved your
 changes, you are asked,
 "Do you really want to quit?
 Type y or n". If you answer "y"
 all unsaved changes are lost.
```

Help Menu 4
Moving the Cursor

```
Home       -- First column
End        -- After last character
PgUp       -- Previous page
PgDn       -- Next page

Ctrl-Home  -- Top of file
Ctrl-End   -- Bottom of file
Ctrl-PgUp  -- Top of screen
Ctrl-PgDn  -- Bottom of screen
Ctrl-Left  -- Left 40 spaces
Ctrl-Right -- Right 40 spaces
```

Help Menu 5
Marking Text

```
                      a = Alt key
[a-B] -- Block mark for
         rectangles, vertical,
         and horizontal lines
[a-C] -- Character mark for
         characters, words, and
         sentences.
[a-L] -- Line mark for one
         line or paragraph

[a-U] -- Unmarks all marks
```

Help Menu 6
Using Marked Text

```
                   a = Alt key
[a-Z] -- Copies marked text,
         leaving original text

[a-M] -- Moves marked text,
         deleting original text

[a-D] -- Deletes marked text

[a-O] -- Overlays marked text,
         leaving original text
```

Help Menu 11
Locating and Changing Text

```
  /text/ -- Locates first
            occurrence

c/old/new/ -- Locates first
            occurrence and asks
            for confirmation of
            change

  [s-F5] -- Confirms change

[c-Enter] -- Executes command
            from the text area
```

Note: For more details, see PE2.HLP file or PE2 Reference Manual

Figure VI-6. Summary of PE2 commands.

can be used to delete the marked area. The command "[print mark]" can be used to print only the marked area.

Move marked text with <Alt>-m. Copy marked text with <Alt>-z. Both of these commands will displace original text to the right (not below or above), whether in Insert or Replace mode. The <Alt>-o command overlays the marked text on top of existing text. To alleviate complications when working with tabular files, set the margins as wide as possible before using <Alt>-m or <Alt>-z. The following is a summary of marked text commands:

<Alt>-m Move text from old to new location. Move old text in new location to right, or below if <Alt>-L used.

<Alt>-z Copy text from old to new location. Move old text in new location to right, or below if <Alt>-L used.

<Alt>-o Copy text from old to new location. (Only with <Alt>-b.) Replace existing text with new text in new location.

Figure VI-5 has the "bare bones" instructions for PE2 editing. Complete instructions are given in PE2.HLP, a printout of which is available by pressing <F7><Enter> when that file is on the screen.

3.4.5 Search and change commands

Any word, number, phrase, or other character string can be quickly found in a file by typing it after a "/" on the command line, then pressing <Enter>. If you leave spaces before or after the string, it will look for these as well. The program will search the entire file starting with the current cursor location.

You may change a character string by typing a SMALL (lower case) "c" and a space before the delimiter ("/" or another character not in the string). In this case, follow the old character string with another delimiter, the new string, and another delimiter. If you want the change to occur for every string after the cursor, type a "*" following the last delimiter. If you want to go backwards from the cursor, type "-*"; if you want the changes to occur in the marked area only, use "*m" or "-*m". A more detailed explanation appears in the PE2 manual.

3.4.6 Retrieving deleted text

If you have changed a given line but haven't left it, you may restore the line to the way it was when you entered it by pressing <Shift>-<F4>. If you mark and delete text, you can get it back by entering the .UNNAMED file. This file is entered with <Ctrl>-u and contains the last five changes to all files in memory up until the time it was last saved. They may be copied back to the text using the move command <Alt>-m described in 3.4.4.

If you have gone beyond the last five changes, you can get the text back only if you quit (<F4>) the file without saving it. Now re-enter it with edit "e", and you will have the file back as it was when you last saved it.

3.4.7 Editing the PE2.PRO file

This file contains preset margins and other specifications that will not ordinarily need changing. However, it is sometimes desirable to customize them by editing this file, just as is done with the initialization files *.INI described in 3.1 and 3.2.

Use the editing procedure described above to edit PE2.PRO. The "blankcompress" value in the second line can be turned off to avoid having to save certain files with NOTABS. However, many files will then require more than twice the storage space. The margins assigned upon entry to a file are usually defined on the third line. The <Alt>-[number] margin presets appear near the bottom of the file. Edit them as required to make formatting of text easier. Other key definitions appear but are not likely to need changing. They may be changed if necessary.

3.4.8 Entering DOS commands from PE2

Entering DOS commands from PE2 is very simple. PE2 has a few DOS commands of its own, such as "dir", "cd", "rename", "save" (<F2>), "file" ("save" and "quit") (<F3>), and "print" (<F7>). These can be entered on the command line, including directory names when needed. The command "dir", however, does not give header and footer information (such as number of files and total bytes used) when requested from PE2 as it does in DOS.

To enter DOS from PE2, type <Ctrl>-d. Type "exit" to return to PE2. Your PE2 work file will still be in the work area, even if you didn't save it.

4.0 DATA TABULATION, INTERPRETATION, AND ARCHIVING

It is essential that a permanent record be kept of the CHAWS AQ and meteorological data. These data are produced in file and tabular form by the software discussed in Sections 2 and 3. This section explains how to interpret, document, and store these data.

4.1 Data processing and quality assurance

Meteorological data are averaged by the HANDAR DCP and put through preliminary QA editing by the RDHAND2 program (run by the LOGIT or GRAPHIT batch files). Once meteorological data are displayed in graphic or tabular form by WXGRAPH, WXSLIST, WXSUM, or other programs, they have had some basic processing.

Any AQ data gathered, however, remain in the form of averaged, uncalibrated voltages until they are translated to parts per billion (ppb) by the AQHRS program (see 2.4.3). Voltages are translated as follows:

ppb = Volts x 100. ppm = Volts / 10.

The AQHRS program uses the first of these formulas to obtain ppb.

When reading the following subsections, then, keep in mind that the *.WX files contain data for 5- and 15-minute averaging periods that have had preliminary quality assurance, but only the meteorological data are translated into the proper units. The *.HR files from the WXSUM output contain hourly data of the same quality as the *.WX files. *.HR files that are created by AQHRS, however, have the proper units for ALL the data, both meteorological and air quality.

4.2 Interpretation of the tabular data

Tables of averaged (avg) meteorological (MET) and AQ data are created by the following programs:

WXLIST -- WXLIST.OUT (5- and 15-minute averaged MET data or AQ volts),

WXSUM -- T[julyr]T2.*.HLY (hourly averaged MET data)

AQHTAB -- AQ[monyr].TAB (hourly averaged AQ data)

RECOV -- RECOV.OUT (data recovery for each 15-minute period)

Several precautions need to be taken when reviewing and interpreting these data. First of all, the parameter values given represent the average values over periods of an hour (except for WXLIST.OUT, where the shortest period is still 5 minutes). Do not assume that the wind directions or speeds include all possible winds within that hour. Wind can vary a lot even within 5 minutes, while temperature, humidity, and even air-pollutant levels may vary considerably within an hour. Important: hourly data are what is generally used in government and industry, but for your own purposes, remember that short-term variations, which may have further implications for your activities, will not necessarily appear in the data base -- especially in the hourly data. Short-term peak values will not appear in most of the tables discussed in this section.

Also, most of the instruments need regular maintenance, servicing, and calibration. If they are not calibrated regularly, the data output will not be reliable. (The U.S. Army has its own calibration specifications, with most Army equipment being calibrated at Redstone Arsenal, Alabama. The calibration procedures for most of the equipment at the CHAWS sites are detailed in the owner's manuals, with some discussion of the AQ equipment in UCID-20988.)

Moreover, it usually requires a meteorologist to find suspect data. One has to know whether a persistent wind direction, for instance, is real or a false reading from a stuck vane. Wild temperature fluctuations are less common than wind fluctuations but can happen under certain conditions.

Finally, a reminder that false negative AQ values are reported as zero in the data files and tables. In the AQHTAB output tables, "<1" means any value between 0 and 0.5 parts per billion. Actual concentrations may be close to zero, but at least a few ppb (say 3 to 10 or more) are usually present. If a "0" appears in these tables, it means the concentration reported in the data is exactly zero or below, and the instrument is at least slightly out of calibration. Rather than show these false negative values, tables produced by WXLIST will show zero instead. Be aware of the percentage of zeros you see in the output. If it's over about half, the following step is essential.

We highly recommend that a printer be installed in each AQ instrument shelter to obtain direct printout summaries of the AQ data at least every 3 to 4 days (twice a week). This printer will obtain data directly off the AQ systems in which the false negative values will appear as a negative value. The elimination of zeros by the HANDAR software will not have taken place, and these negative values can be used to recalibrate the analyzers as necessary.

(For details, see UCID-20988, which includes calibration of the AQ System.)

4.3 Archiving of tables

Each of the tables created by AQHTAB and RECOV should be printed and kept in a binder. Printing and archiving bulky WXLIST.OUT printout or the *.HLY tables (see subsections 3.2.1 and 3.2.2) is not recommended but may be done at the option of the user. Recommended procedures for storing these tables are as follows:

4.3.1 WXLIST

WXLIST.OUT output tables, printed at the option of the user only for very short periods of episodic conditions, potential release conditions, or interesting meteorological events, are stored by event or chronologically in a large 3-inch binder.

4.3.2 WXSUM

*.HLY tables (if desired), are stored chronologically in 3-ring looseleaf binders by the year. An entire year would be from about 2200 to 4400 pages (depending on the site) and require 3 to 5 large 3-inch binders.

4.3.3 AQHTAB

Monthly AQ*.TAB tables (Table VI-4) are stored chronologically in a 3-ring looseleaf binder. An entire year fits in a 1 1/2-inch binder.

4.3.4 RECOV

RECOV.OUT tables (Table VI-5) are stored chronologically in a 3-ring looseleaf binder. Using the output described in Section 4.5, tabulate each day's percentage data recovery rate by hand. Now, insert the results in front of the RECOV.OUT tables for that month. An entire year of these tables fits into a 1 1/2-inch binder.

Procedures for running the programs that create these tables appear in 3.2, and program applications and examination of the data are discussed below.

4.4 Archiving of data files (*.WX, *.HR)

Raw 5- and 15-minute averaged data should be archived on 5 1/4-inch floppy disks in the *.WX form, while processed data should be saved in the *.HR form after running WXSUM (and AQHRS for sites with AQ data). The ASCII files "*.HLY" are easily reproduced with the WXSUM program and do not have to be kept. (If you want to keep them, you can also keep the printed output tables as discussed above.)

4.4.1 Archiving of the 15-minute data periods (*.WX Files)

*.WX files are created by the RDHAND2 program (see 2.3.6). Before archiving them, make a preliminary search to ensure all data obtained are in one place. Check the hard disk and other floppy disks at your base for any missing files. If you can't find certain days or periods, call LLNL and the ASL at White Sands Missile Range to see if they are available.

Use the DOS COPY command (see 3.3.6) to store the *.WX files in consecutive order, fitting as many onto each 1.2-Mbyte floppy disk as possible. For Tooele, for example, 17 *.WX files should fit easily onto a 1.2-Mbyte floppy disk. If this size is not available, temporary storage on 360-kbyte disks is permissible, but later transfer to the 1.2-Mbyte disks is recommended for economical storage.

If you find any missing files at a later time, copy them onto the floppy disks using the COPY command in DOS. Delete the older *.WX files from the floppy disk if the available storage is exhausted. It is helpful to keep a DIR listing of the contents of each floppy disk in its sleeve. Write the percentage of data recovery on this list when available (see 4.5).

Construct a label for each floppy disk as in Figure VI-7 after being sure you have all the possible files for that period. You can use the figure or the file "CHAWSLAB.[yr]" for the format and even type labels beforehand if you prefer, leaving the dates, Julian dates and floppy disk numbers blank. Fill these in as you store the *.WX files. The project and file type should appear on the top line, with the site name on the second line.

Inclusive dates and Julian days appear on the third and fourth lines. The last line should contain a disk number, preceded by the site initial (T, E, P, or L, as appropriate), and should be labeled in consecutive order. Remember to put your initials in the lower right corner of the label.

SHORT-TERM *.WX FILES

CHAWS *.WX files
Tooele A.D. South
15 Apr.-6 May '86
Julian: 105 - 125
T01, Init.

CHAWS *.WX files
Tooele A.D. South
6 - 22 May'86
Julian: 126 - 142
T02, Init.

CHAWS *.WX files
Tooele A.D. South
23 May-8 June '86
Julian: 143 - 159
T03, Init.

CHAWS *.WX files
Tooele A.D. South
8 June- 2 July'86
Julian: 160 - 183
T04, Init.

LONG-TERM *.HR FILES

CHAWS *.HR files
Tooele A.D. South
15 Apr-30 Sept '86
Julian: 10586-27386
Th01, Init.

CHAWS *.HR files
Tooele A.D. South
1 Oct'86-23 Mar'87
Julian: 27486-08287
Eh01, Init.

Figure VI-7. Sample labels for *.WX and *.HR files.

When you have a year's worth of data or have filled a floppy diskette box (whichever comes first), prepare a label for the box. This label should have the same basic format as the individual disks, with the addition of the 4-digit year number at the top of the label. If a box spans 2 years of data, put the last two digits of the year at the end of the Julian date numbers for clarity (i.e., "27486", as for the *.HR files in Figure VI-7, part B).

Before permanent storage, all diskettes should be write-protected. This is done by wrapping a small piece of tape around the indented portion of the disk on the upper right side. Small 1- by 1/2-inch pieces of tape are provided in each diskette box for this purpose.

4.4.2 Archiving of the hourly data periods (*.HR files)

Hourly averages of the meteorological data are to be computed at least monthly using the WXSUM program and organized into files or tables. These tables may be saved in up to three different ways: displayed on the screen at run time, printed by a printer at run time, or saved in *.HLY files (see 3.2.2). The most convenient way to use the results is to save them as *.HLY files and examine them on the screen for any suspect data periods (remember that any AQ data gathered will not appear in these tables and so cannot be examined at this stage). Only the suspect data periods or phenomena of interest should be printed out and kept in a binder, as discussed above.

When running WXSUM for the first time, answer yes to the "File *.HR?" question on the user-input screen, which then stores the data in binary form. These binary files are added to the WXOBS subdirectory, along with the *.HLY files (if requested) and the *.WX files. If you have AQ data, run AQHRS as discussed in 3.2.3. The *.HR files may then be read by programs like AQHTAB.

Store the *.HR files on 360-kbyte floppy disks, unless 1.2-Mbyte disks are more convenient. Each 360-kbyte disk holds 47 *.HR files from the Tooele site. Therefore, two years of Tooele data occupy 16 disks, which can be stored in one floppy diskette box. If 1.2-Mbyte disks are used, 161 files will fit on a disk for the Tooele site. A year could be stored on two disks.

Labels of the *.HR files are similar to those for the *.WX files (see Figure VI-6). If a floppy disk or disk box includes data spanning two years, designate the range of Julian dates by putting the last 2 digits of the year at the end of each Julian date. An example is shown in the figure. Remember to put the years at the top of the box label as well.

4.5 Data recovered (RECOV)

When compiling a data base, it is essential to keep track of the daily and monthly percentages of data recovery. For periods of low recovery, it is also helpful to look at the status of each instrument. For these purposes, you should run the RECOV program, which keeps track of each 15-minute period for each station and channel, reads the raw *.WX files, tallies the valid and missing ("M") data periods, and creates the file "RECOV.OUT". One such file is shown in Table VI-5.

Start this program as described in 3.2.6 and run it for each day (i.e, each *.WX file). The "RECOV.OUT" file should be printed each day, separated, and inserted into a three-ring binder as discussed previously.

Prepare each "RECOV.OUT" file for printing by inserting the correct printer-control characters. The program generates certain characters in the upper left corner of the screen. Although these characters cannot be reproduced here in printed text, they do change the printer parameters. Where the RECOV program has written "A←2", use <Alt-9> (9 from numeric keypad) in PE2 to change this to something that looks close to "Ao←2". This is done by typing "c/A   /A<Alt-9>/*" <Enter> (four spaces after A) on the command line. Now print the files using only PE2 by striking <F7> <Enter>.